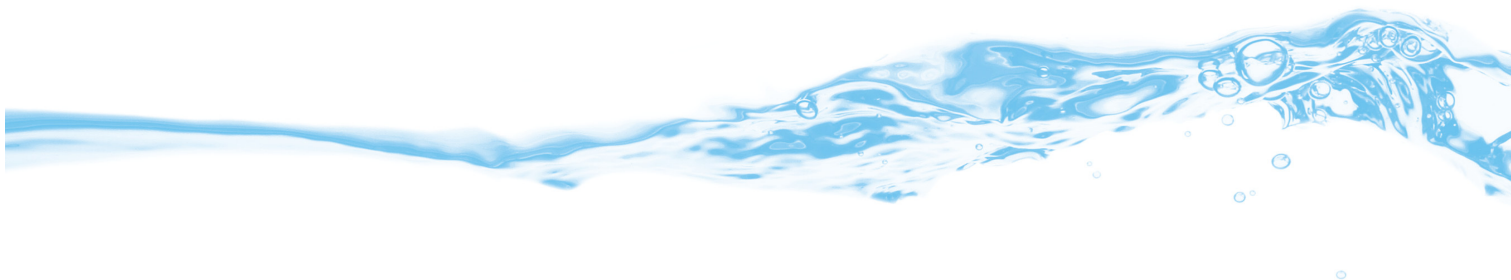




YorkshireWater

ADAPTING TO CLIMATE CHANGE

MAINTAINING LEVELS OF SERVICE IN A CHANGING CLIMATE



**Reporting to Defra in support of the national
Climate Change Risk Assessment,
as directed under powers in the Climate Change Act (2008)**

JANUARY 2011

To contact us regarding our Adaptation Report

If you wish to contact us regarding this report or other matters relating to climate change or carbon management, please e-mail our Climate Change Strategy Manager, Gordon Rogers, at:

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FOREWORD



I am delighted to publish our 'Adapting to Climate Change' report which aims to support the Government in its activities to prepare the country for the challenges of climate change. As climate change has been described as the greatest environmental threat of this century, it is a top priority of the Government, our customers and the company.

This report provides an assessment of the current predicted impacts of climate change and a statement of our proposals, policies and timescales for adapting.

Yorkshire Water assets built today will still be serving customers at the end of this century. It is essential that we continually adapt to the impacts of the changing climate, for example to flooding caused by more extreme rainfall.

Therefore, we will continue balancing customer service, environmental improvements, customer bills and returns for our investors in both the short and long term.

Our customers are at the heart of our business. When we asked about their priorities, our customers told us they expect safe water supplies and flood prevention without having to think about it. To respond effectively we must form part of a more sustainable society where an appreciation of the true value of water will encourage greater integration of water supply, drainage and flood defence assets.

Adapting to climate change gives us the opportunity to think beyond the current conventional approach to water in this country; to consider the whole water cycle as one. Such an approach can achieve effective long term water and drainage management in the most cost effective way. There is a window of opportunity in this time of regulatory review, to shape a sustainable industry which is fit for the future.

The water industry's current five year regulatory price review framework has recognised climate change through its support of resilience investment, research and long term planning. The existing regulatory framework would be strengthened by the incorporation of future requirements for adaptation reporting. This would add further drive to the industry's response to climate change.

Working at the heart of the water environment, we are keen to build on our technical and financial expertise and to maximise the use of our significant asset base to support society in responding to the pressures of climate change. We have the opportunity to adapt our assets effectively whilst delivering a more sustainable society, for example by fundamentally reviewing the ownership, management and access to flood defences. Such a review could facilitate a more coherent approach to flood management and release public sector resources. We could also help reduce flooding from sewers and enhance environmental protection by separating surface water from the sewerage systems. These changes could provide even better value for money for our customers and enhanced cost benefit for wider society.

As a progressive and aspirational company dedicated to continuous improvement we are well placed to adapt effectively and maintain our high levels of service in the face of a changing climate. By working innovatively with our partners, regulators and the Government, we can maximise the opportunities for society in our response to climate change.

A handwritten signature in black ink, appearing to read 'R D Iland', written in a cursive style.

1. EXECUTIVE SUMMARY

About this report

Yorkshire Water has been legally directed by the Government to report on our climate change risks and response plans. We were identified as one of ninety organisations who manage critical services and infrastructure that may be of particular relevance to the national Climate Change Risk Assessment (CCRA) which is currently being produced by the Department for Environment, Food and Rural Affairs (Defra).

In producing this report and executive summary we have followed statutory guidance provided by Defra (Defra, 2010). This executive summary provides a short overview of each section in order to act as a guide to the main report. In Appendix 1 we have included the Defra executive summary template from the statutory guidance.

Introduction (see Section 2)

Yorkshire Water provides essential water and waste water services to over two million homes and businesses across the Yorkshire region. Our customers are at the heart of our business and we have asked about their priorities. They have said for example, that they expect a safe water supply without having to think about it. Our ability to meet this priority by delivering reliable, quality water and waste water services is intrinsically linked with the weather and long term climate. Therefore, the changing climate poses a significant challenge to our ability to maintain levels of service. Climate change could impact all parts of our organisation: assets and operations; services to customers; environmental performance; supply chain; and investors.

In response to this challenge and our customers priorities, we identified climate change as a top ten priority in our long term objectives which were published in our 2007 Strategic Direction Statement (SDS), 'Striking the right balance for Yorkshire'. We identified the priority to **mitigate our carbon footprint and adapt to climate change**.

Our approach to climate change identifies three core elements: **Adaptation, Mitigation and Communication**. The preparation for this report has proved useful in reviewing our activities and helping us further embed climate change risk management within our organisation. We are addressing climate change mitigation with equal vigour. Communication is essential in sharing and learning between academia, other sectors, the Government, regulators and our customers.

Climate change in the Yorkshire and Humber region (see Section 3)

Climate projections show that our region can expect trends for warmer and drier summers, milder and wetter winters, sea level rise and more extreme weather events. These are the general findings of the 2009 UK Climate Projections (UKCP09) which provide the most robust climate change projection data available to us. We have used UKCP09 in our latest climate change risk assessment and we are working to incorporate its full functionality into our business. It was unfortunate that UKCP09 was published too late for thorough inclusion in our preparations for the last regulated Price Review which completed in 2009.

The probabilistic approach of UKCP09 shows the significant range of potential climate change predicted by the climate models used to generate the projections. In addition, our research with Cranfield University concluded that projected impacts of future climate change in our region have been smaller

and the direction of change less certain when compared to some other regions (Cranfield University, 2010). This makes it difficult to draw conclusions on when to respond and to what extent.

In reality we have all experienced the impacts from numerous extreme weather events in recent years, for example the floods of 2007. These actual events indicate the issues we may have to deal with more regularly as the climate changes. Therefore, our current investment to improve asset resilience will support long term climate change adaptation.

Managing climate change in the water industry (see Section 4)

Our current water industry regulatory investment regime works well and it has gained the confidence of customers, environmental regulators and investors. The regime is a vital element of the water industry's ability to adapt to climate change effectively. The five year regulatory Price Review framework has recognised the need to respond to climate change and extreme weather, for example through its support of resilience investment, research and long term planning. We believe this should continue and any future requirements for adaptation reporting should be integrated to add further strength to the regime.

We recognise the need for a more integrated, overarching approach to water cycle management in order to adapt effectively. As requested in the statutory guidance, we identify current 'barriers to adaptation' and we suggest how these present opportunities that will help shape a more sustainable water industry. These can be found in Table 1 of Section 4.

Our approach to climate change is evolving and developing, aided by our engagement in national and regional forums, networks and research projects. We are actively involved with UK Water Industry Research (UKWIR), who manage various national research projects on climate change in the water industry. The Water UK Climate Change Group enables effective collaboration and communication with other water companies, the Environment Agency and the Office of Water Services (Ofwat - our economic regulator).

We recognise that we can not adapt in isolation. As a large, regional organisation, we have a large number and a wide variety of stakeholders that we engage with in a variety of ways. We have started to communicate with many of our stakeholders about climate change in order to fully consider the interdependencies and opportunities that may exist between us. We seek a collaborative approach to adaptation and our engagement and communications will continue and increase.

Climate change risk assessment (see Section 5)

Effective risk management is fundamental to our business. Over the last fifteen years we have consistently pushed the boundaries of industry best practice. We have embedded risk management in the long term planning and day to day operations of our business. Risk management of the impacts of weather and climate are managed at both a strategic (or whole company) and business (or service) level. Two examples of this business risk management were included as part of the recent Price Review submission to Ofwat, including water resources management and asset flood resilience.

An integrated, flexible approach to climate change risk management is essential as we continue to develop our detailed understanding of the potential impacts to our assets and services from the changing climate. As a result, we continue to evolve our climate change risk management approach in line with our latest understanding.

At a company strategic level we are currently undertaking a second cycle of qualitative climate change risk assessment of all our main business functions and we are embedding climate change risk management throughout our organisation.

Our latest climate change risk assessments use the context of UKCP09 (improving on the previous 2002 projections) and timescales that align with our short, medium and long term planning requirements. We aim to develop quantitative climate change risk assessment. This will require, for instance, understanding of the scale and frequency of future extreme weather events to determine probability and impact. This is an area which we continue to focus on.

Our current activities to build adaptive capacity (see Section 6)

Our business plan for the current five year regulatory period runs from 2010 to 2015 and includes numerous activities which support climate change adaptation. For example:

- Our largest ever climate change research and investigation programmes
- Our water resources plan is an established strength and incorporates climate change projection data. Our suite of models will be used to forecast our water resource supply and demand balance and optimise our fully integrated approach
- Enhancing our sewerage and river network models to determine numerate thresholds and probabilities for future planning and investment. We are planning to integrate the water, sewerage and river networks to enable an optimised approach - we call this real time river integration (rtRIVERi)
- Investing to improve the resilience of our assets to extreme weather.

Conclusions (see Section 7)

In this report, we review our current status, the start of our future response to climate change. Our immediate adaptation priority is to continue developing our knowledge and our adaptive capacity. In meeting this priority it will be essential to work collaboratively and we are therefore working with leading universities, the UK Climate Impacts Programme (UKCIP), regional Government and UKWIR. As we adapt effectively to the changing climate there may be opportunities for us to support wider society through innovative, joined-up approaches. We are well placed to respond to the long term challenges of climate change.

2. INTRODUCTION

2.1. SECTION SUMMARY

- Yorkshire Water is a water and waste water company with 4.9 million domestic and 130 000 business customers. We are one of the ninety Reporting Authorities that have been directed to report in support of the developing national Climate Change Risk Assessment (CCRA)
- Our 25 year Strategic Direction Statement (SDS) describes our long term plans and identifies climate change as one of our top ten priorities. We highlight our need to undertake strategic research in to the effects of climate change on our overall infrastructure before revising design standards
- This section describes a summary of our functions and future direction.

2.2. SCOPE

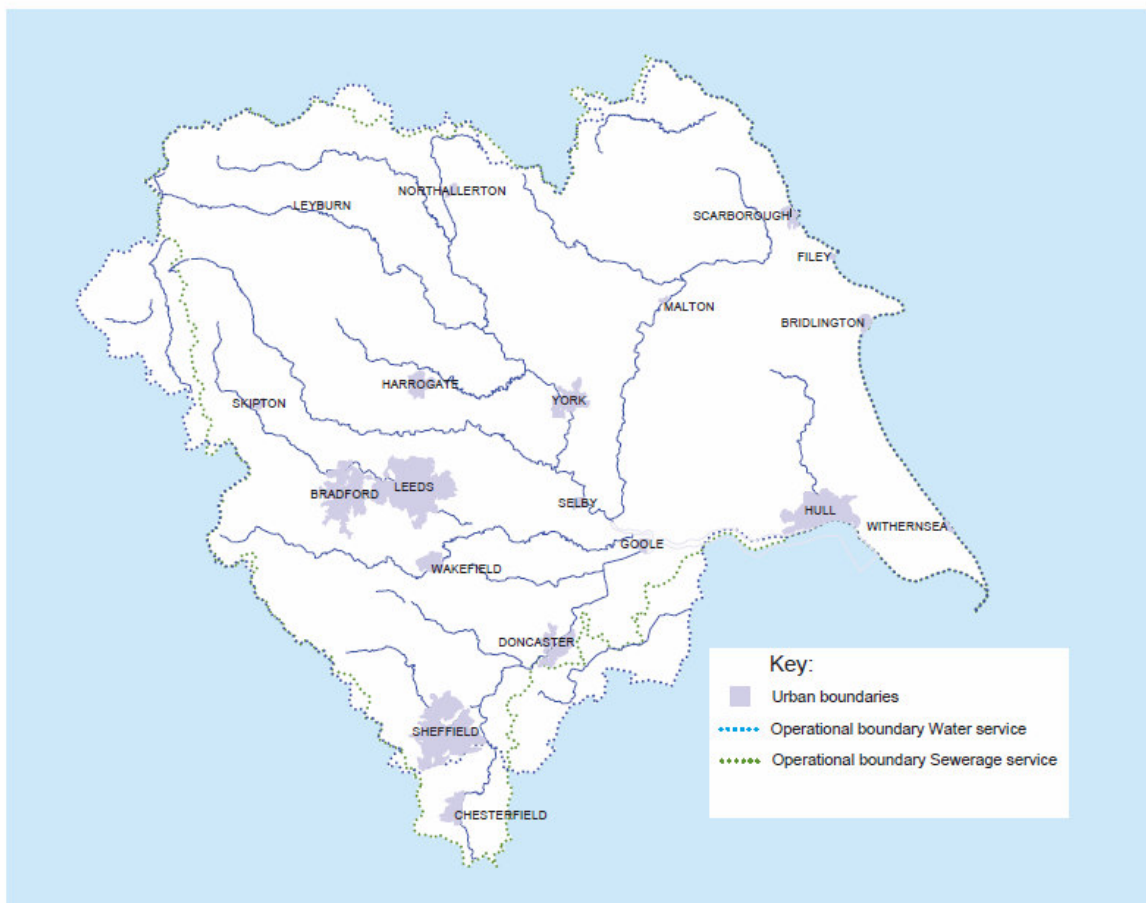
1. This report has been produced in response to a Direction received from the Secretary of State for Environment, Food and Rural Affairs in February 2010, using reporting powers within the Climate Change Act (2008). This report has been structured to follow the requirements of the Direction and associated statutory guidance (Defra, 2010). Our Direction can be found in Appendix 2. In summary, this instructed us to report the following:
 - A summary of our functions
 - Our methodology for assessing the impacts of climate change to our organisation
 - Our understanding of the potential impacts of climate change to our organisation
 - A statement about our proposals and policies for responding to the potential impacts of climate change, including timescales.
2. This report has been developed by a cross-business working group which has ensured risks to every aspect of our business have been reviewed. This group have considered relevant guidance from the Department for Environment, Food and Rural Affairs (Defra), the Environment Agency (EA) and other organisations. Our engagement process has included, for example our independent Environmental Advisory Panel (EAP) which includes many of our key stakeholders.
3. Our Directors have approved the report and have been regularly updated on its development and our wider programme to embed climate change risk management within our organisation.
4. Throughout the development of this report we have worked collaboratively with the water industry through the Water UK Climate Change Group. We recognise that further engagement is needed to fully consider interdependencies and collaborative opportunities, for example with the energy and transport sectors.

5. We continue to develop our understanding of the impacts of climate change to our assets and services so that we can adapt effectively. We highlight our many areas of good progress and we fully recognise that there is a significant challenge ahead for our organisation, for the water industry and for wider society.

2.3. ABOUT YORKSHIRE WATER

6. We are a licensed water and sewerage undertaker, appointed through powers within the Water Industry Act (1991). We collect, treat and distribute around 1.3 billion litres of drinking water each day through 30 900 km of water network. We then collect, treat and return safely back into the environment just less than 1 billion litres of waste water through 30 500 km of sewer networks.
7. We serve a population of approximately 4.9 million people and around 130 000 businesses. As shown in Figure 1, our operational boundary extends beyond Northallerton in the North to Chesterfield on the edge of Derbyshire in the south; and from West of Skipton right across to Scarborough and Withernsea on the East coast. We are one of the largest land owners in the region, responsible for around 71 000 acres, including over 11 000 acres of Sites of Special Scientific Interest (SSSI).
8. You can find out more about us at our website, www.yorkshirewater.com.

Figure 1 – The Yorkshire Water region, showing operational boundaries for water and sewerage services



2.3.1. Our strategic direction statement – our long term objectives and priorities

9. In 2007, we produced our SDS for the 25 year period from 2010 to 2035. We identified five long term objectives through consultation with our customers and stakeholders:

- Provide a **customer experience** second to none
- Have a strong environmental focus
- Deliver the **lowest possible prices** for customers
- Provide **attractive returns** for investors
- Delivered through world class asset management and great people.

10. We highlighted ten priorities in support of our strategic direction, including one to mitigate our carbon footprint and adapt to climate change. We noted the uncertainties around the detailed effects of climate change and our plan to undertake strategic research.

11. For further detail, our SDS can be found at the following link:

http://www.yorkshirewater.com/medialibrary/PDF%20files/Strategic_Direction_Statement.pdf

2.3.2. Our climate change strategy

12. To help ensure we continue to provide a coherent, joined-up approach to climate change we are currently developing an overarching climate change strategy for our business. Our strategy includes three main elements:

- **Adaptation** - maintaining levels of service in a changing climate
- **Mitigation** - sustainably reducing emissions to minimise future climate change
- **Communication** - collaborating to deliver an effective response to climate change.

13. This report has proved valuable in the continued development of our climate change strategy.

3. CLIMATE CHANGE IN THE YORKSHIRE AND HUMBER REGION

3.1. SECTION SUMMARY

- The UK Climate Projections (UKCP09) show general trends for warmer and drier summers, milder and wetter winters, sea level rise and more extreme weather events
- We have summarised two sources of climate change projections for the Yorkshire and Humber region over the 21st century – from UKCP09 and from the Yorkshire and Humber Regional Adaptation Study
- The general trends shown in climate change projections could have significant impacts to our assets and services.

3.2. NATIONAL CLIMATE CHANGE PROJECTIONS

14. UKCP09 uses climate model simulations and the latest scientific understanding in order to project climate change to the end of this century. UKCP09 is the fifth generation of climate change information for the UK (<http://ukcp09.defra.gov.uk/>). The projections are presented for three different future scenarios representing High, Medium and Low greenhouse gas emissions. There is inevitably a degree of uncertainty associated with future climate information and the projections are therefore probabilistic, showing the range of possible outcomes to allow for a measure of the uncertainty.

3.3. CLIMATE CHANGE PROJECTIONS IN THE YORKSHIRE AND HUMBER REGION

15. The Yorkshire and Humber Regional Adaptation Study used the fourth generation of UK Climate Projections (UKCIP02) to investigate the impacts of climate change on the region, up to the year 2050. The study was led by a number of organisations who formed a partnership in the region and in which Yorkshire Water remains actively involved. The full study can be found at www.adaptyh.co.uk. The key climate changes identified are summarised below:

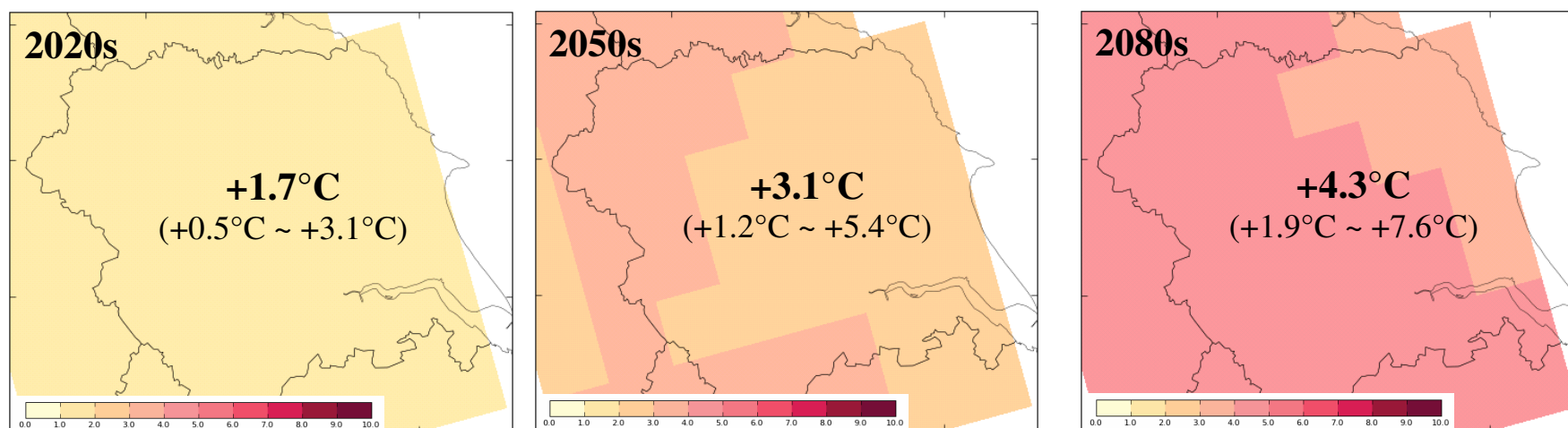
- Summary overview of the key impacts in the Yorkshire and Humber region by 2050, based on the medium-high emissions scenario of UKCIP02:
- Annual average daily temperatures rising, by almost 2°C
- Extreme hot temperatures will increase, with summer temperatures more regularly reaching 34°C
- A reduction in annual rainfall of up to 6%, although by less in upland areas
- Greater seasonality of rainfall, with increases in winter combined with significant reductions in summer
- In northern and upland areas an increase in the number of extreme rainfall events
- Dry spells (over 10 consecutive days without rain) are expected to increase in number
- Significant reductions in the number of days of frost and snow
- Marginal increases in winter average wind speeds, although summer and autumn speeds reduce slightly
- Sea levels will rise by around 0.35 meters.

(The Yorkshire and Humber Assembly, *et al*, 2009)

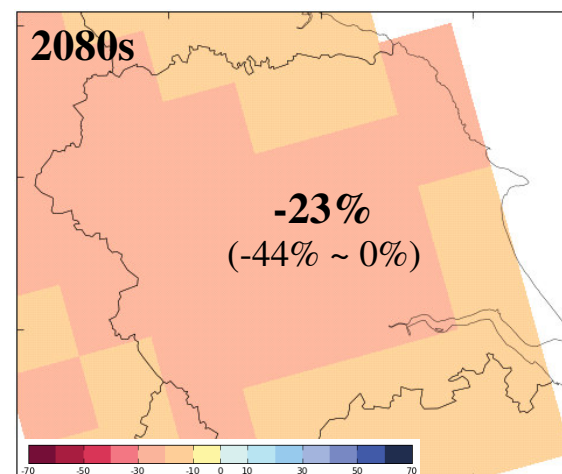
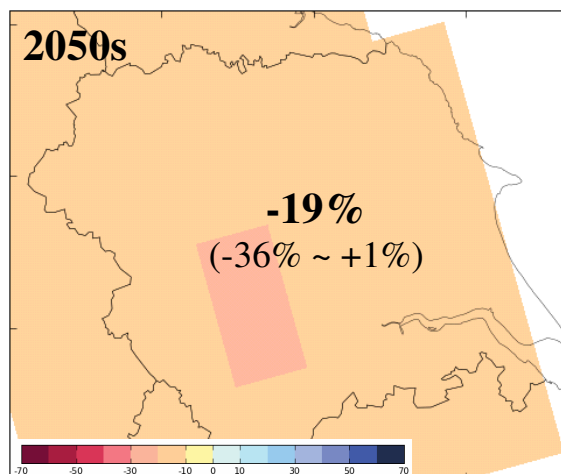
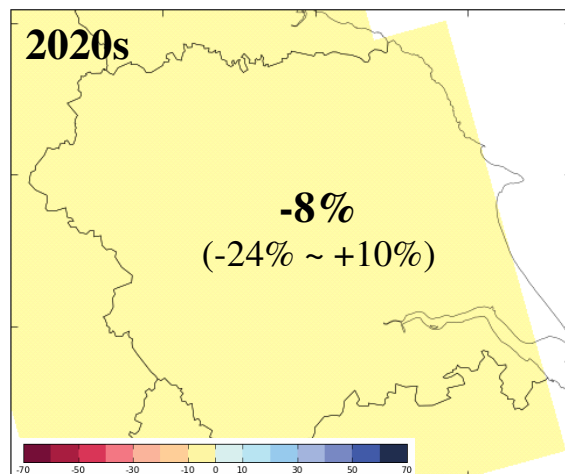
16. Since the completion of the Regional Adaptation Study, the 2002 projections have been replaced by the more comprehensive 2009 projections. UKCP09 shows similar trends, for:
 - Hotter, drier summers
 - Wetter, milder winters
 - Sea level rise
 - An increase in extreme events.
17. Whilst the general climate trends remain very similar to that of UKCIP02, there is a great deal more information to users of the projections, including probability. In Figures 2 and 3, we show an indication of the climate change that is expected in the Yorkshire and Humber region over the 21st century, using the medium emissions scenario from UKCP09.

Figure 2 – UKCP09 climate projections for the Yorkshire and Humber region

For the three climate characteristics shown below, we show how the UKCP09 projected climate change alters over time. This data is from the medium emissions scenario and is compared to the 1961 to 1990 baseline. The 50th percentile figure is shown in bold font to indicate the central estimate. The 10th and 90th percentile figures are shown in brackets to demonstrate the likely potential variability.

Summer Mean Daily Maximum Temperature Change (°C)

Summer Mean Precipitation Change (%)



Winter Mean Precipitation Change (%)

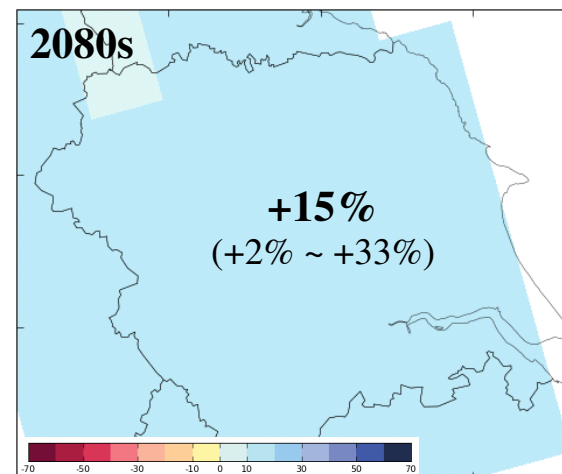
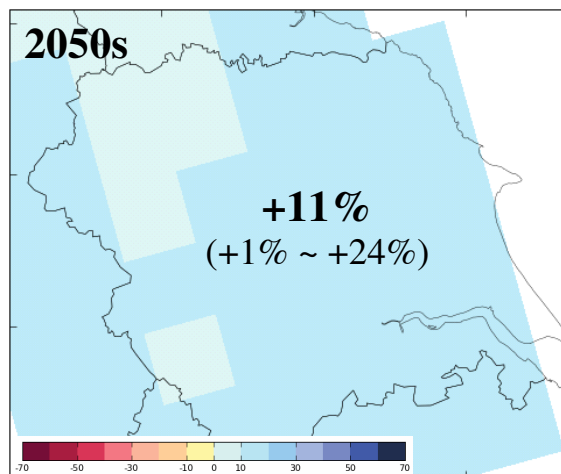
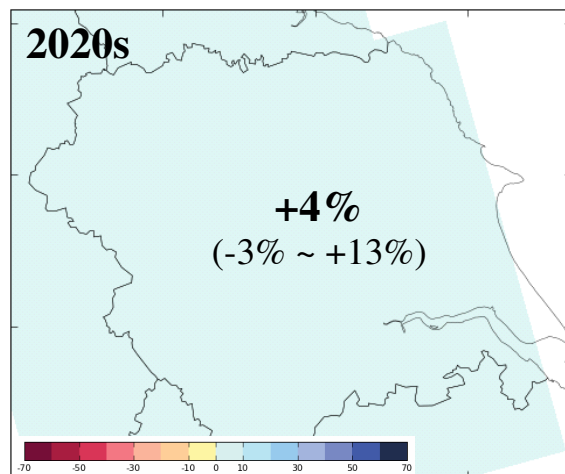


Figure 3 – Projected sea level rise at Hull

UKCP09 data showing how relative sea level rise projections alter over time at Hull. This data is from the medium emissions scenario and is compared to the 1961 to 1990 baseline. The 50th percentile figure is shown in bold font to indicate the central estimate. The 10th and 90th percentile figures are shown in brackets to demonstrate the likely potential variability.

<u>2020s</u> +11cm (+6cm ~ +17cm)	<u>2050s</u> +24cm (+12cm ~ +36cm)	<u>2080s</u> +39cm (+18cm ~ +60cm)
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3.4. *CONCLUSIONS*

18. The latest national projections (UKCP09) show that our region is expecting warmer, drier summers and milder, wetter winters, along with sea level rise and more extreme weather events. The projections also show that the level of climate change increases through the century, as does the uncertainty in the exact level of change we might expect. Data and information about future climate change, and its potential impacts, continues to evolve rapidly as everyone's understanding in this field develops to maturity.

4. MANAGING CLIMATE CHANGE IN THE WATER INDUSTRY

4.1. SECTION SUMMARY

- As part of the regulated UK water industry, we operate within a five yearly Price Review framework which requires robust evidence based justification of investment proposals to enable our regulator, the Office of Water Services (Ofwat), to approve business plan proposals
- The Price Review process has served the industry and our customers well. It has recognised climate change through its support for asset resilience and research in our current business plan, which is supporting our Strategic Direction Statement (SDS) priority to adapt to climate change
- The five yearly review supports a responsive investment approach that evolves with our understanding of the changing climate
- We highlight a number of potential 'barriers' to effective adaptation and we make a series of recommendations which could help overcome these issues and maximise the opportunities of adaptation
- To prepare effectively for adaptation will require a multi-agency, joined-up approach. We seek to use our expertise and continue to work collaboratively in support of such an approach.

4.2. THE REGULATORY FRAMEWORK OF THE WATER INDUSTRY

19. The water industry regulators and their main functions are listed below in alphabetical order:
 - **Consumer Council for Water** (CCWater) ensure we effectively balance the interests of our water and sewerage consumers
 - **Drinking Water Inspectorate** (DWI) ensure we provide safe, wholesome drinking water
 - **Environment Agency** (EA) ensure we protect the environment whilst carrying out our operations
 - **Natural England** (NE) ensure we protect wildlife and habitats whilst carrying out our operations
 - **Office of Water Services** (Ofwat) ensure customers receive good quality service by the most economic and efficient means.
20. We operate within a regulated five year business planning cycle, known as the Price Review. For each five year period we submit an Asset Management Plan (AMP) to Ofwat for approval. The regulated framework ensures that investment plans are supported by robust evidence and a full cost benefit appraisal. Our current water industry regulatory investment regime works well and it has gained the confidence of customers, environmental regulators and investors.

21. Ultimately, water and waste water services come at a cost and it is important that customer bills are reasonable and affordable. Therefore, as part of our AMP activities we undertake a 'Willingness to Pay' survey. This quantifies how our customers and stakeholders value the range of services we provide and it evaluates the extent to which they are willing to pay for maintaining or improving these services. We must retain and build upon the support of our customers and the wider community if we are to respond effectively to climate change. We consider this matter further in Table 1 and Section 4.4.

4.3. *CLIMATE CHANGE AND THE REGULATORY REGIME*

22. In July 2008, Ofwat published a Climate Change Policy Statement (available at www.ofwat.gov.uk) which set out how climate change is expected to affect the water and waste water sectors in England and Wales. Our climate change adaptation planning must comply with Ofwat's policy guidance.
23. Ofwat classified seven areas needing to be addressed for climate change adaptation:
- Water resources
 - Leakage targets
 - Water efficiency
 - Water quality and treatment
 - Maintaining serviceability
 - Drainage
 - Resilience.
24. Ofwat also recognised that climate change should be treated within other overarching issues rather than in isolation, covering the following issues:
- Sustainability
 - Competition and innovation
 - Consumer charges
 - Consumer expectations and behaviour.
25. In responding to climate change, we feel that the water industry's five yearly Price Review cycle is a strength because planning and investment decisions are always made in line with latest understanding. This approach offers an opportunity to 'check and re-align' long term planning with latest knowledge and understanding, which continues to evolve rapidly.
26. The regulatory regime is a vital element of the water industry's ability to adapt to climate change effectively. It recognises the need to respond to climate change and extreme weather through, for example, its support of resilience investment, research and long term planning in our AMP5 plan. Future requirements for adaptation reporting could be efficiently

integrated and aligned within the Price Review process as part of established long term planning.

27. We also believe there is a need for a more integrated, overarching approach to water cycle management in order to adapt effectively. This is one of a number of suggestions we have which will help shape a more sustainable water industry that is fully prepared for the changing climate. In the statutory guidance, these are called ‘barriers to adaptation’. These are summarised in Table 1 below, with further details in Appendix 3.

Table 1 – Barriers to effective climate change adaptation

Summary of potential barriers	Recommendations for the Government	Recommendations for water industry Regulators	Action by Yorkshire Water
A national vision and framework for adaptation			
No consistent methodology for climate change impact assessment or response evaluation.	Develop a national vision and framework for climate change impact assessment and response evaluation, communicating clear expectations of organisations involved.	Engage with the Government and the water industry to help shape an effective national vision and framework which enables the water industry to act confidently when preparing for climate change.	Actively support the Government and regulators in developing a national vision and framework for adaptation.
Interdependencies – integrated water management planning			
Effective adaptation in the UK will require a more joined-up approach to all aspects of our country's water management activities. For example, climate change adaptation of our sewer network needs to be considered alongside surface water management and sustainable urban drainage.	<p>Ensure a holistic, joined-up framework for water management in the UK. The water and waste water companies are intrinsically linked to the water environment and may have a greater role to play in the future, having demonstrated their ability to manage their assets and operations effectively since privatisation.</p> <p>There are opportunities to adapt our assets effectively whilst delivering a more sustainable society, for example by fundamentally reviewing the ownership, management and access to flood defences. Such a review could facilitate a more coherent approach to flood management and release public sector resources.</p>	Continue to engage with the Government and the water industry to ensure a holistic, joined-up framework for water management in the UK.	Continue to work collaboratively with the Government and our regulators, using our technical and economic expertise to consider options for holistic, integrated water management. The nature of our business and the location of many of our assets mean that we are intrinsically linked to the water environment and are therefore well placed to have a strong role in this debate.

Water industry regulation – the Price Review cycle			
Whilst the five year Price Review cycle within the context of a long term SDS supports adaptation, the main emphasis is on short term planning for the next five years.	Continue to support the current five year Price Review. Encourage long term, strategic planning in the water industry, for example by clarifying expectations of organisations involved.	Engage with the Government and the water industry to develop mechanisms that ensure the water industry is effectively planning for the long term.	Actively support the Government and regulators in developing effective long term planning.
Water industry regulation – customers willingness and ability to pay			
Customers may not be willing or able to pay for the investment required to ensure future levels of service. Is it right for today's customers to pay for future protection? How does the industry ensure action is affordable?	We feel these issues require open debate, which the Government could hold within its current review of the water industry. Is there a case for alternative funding mechanisms?	Actively contribute to the debate.	Actively contribute to the debate.
Water industry regulation – quality compliance			
Existing water quality compliance regime's can be inflexible and do not allow for the optimal, most sustainable approach. For example, requiring high waste water effluent standards at all times in order to protect the receiving river. However, an optimised treatment approach would be responsive to the real time state of the natural environment - treating to higher standards in very low flows, or more relaxed standards in high flows. In addition, new environmental water quality	Encourage regulators to review their methodologies for determining existing compliance standards (which can often be outdated), to ensure they are based on the best science and information. This may allow 'legal' standards to be reduced whilst maintaining the 'real' level of protection to customers and the environment. More flexible consenting approaches may provide new opportunities to balance both aquatic and atmospheric environments as well as operational efficiency.	Engage with the Government to support the development of sustainable legislation. Review methodologies for determining compliance standards to ensure they are based on the best science and information. Review standards (positively or negatively) to ensure effective 'real' levels of customer and environmental protection	Twin track approach to ensure compliance with all legal duties whilst researching and innovating to find new, more efficient ways of meeting legal requirements. For example, our rtRIVERi approach described in Section 6. Actively support our regulators in determining effective compliance standards based on latest science and information.

legislation can restrict asset flexibility by forcing the need for robust assets (often fixed, substantial structures) with long asset lives and energy intensive processes needed to guarantee compliance with strict standards. As a result these assets can be inflexible to future modification for climate change. In addition, these assets often have substantial embedded and operational carbon footprints.	Ensure that the requirements of any new environmental legislation are sustainable, both economically (affordable, with clear cost benefit), socially (supports flexibility for adaptation) and environmentally (protecting the holistic environment, not just the water environment). We believe that environmental improvements should only be proposed where the benefits exceed the carbon impacts.		
Water industry regulation – resilience through renewable energy self-generation			
Self-generation of renewable energy can substantially improve the resilience of critical infrastructure to external factors, such as power loss in the national grid (as well as many other benefits). The water industry is not currently able to maximise the pursuit of the benefits from renewable self-generation due to an Ofwat policy position.	<p>Allow the water industry a more flexible approach towards renewable energy self-generation so that the industry can build resilience and support the Governments wider aims for carbon mitigation.</p> <p>Introduce a strategy similar to that being proposed in Scotland, empowering the water industry in England and Wales to maximise the potential of their assets and operations for renewable energy generation, thereby growing the benefit the industry brings to society.</p>	For Ofwat to review their policy position on renewable self-generation to enable water companies to maximise the potential benefits for customers and society.	<p>Continue to develop our renewable self-generation portfolio as permitted within the current regulatory framework. Our aim is to develop our capacity to self-generate 15% of our own electricity by 2015.</p> <p>Engage with the Government and our regulators to encourage flexibility in the pursuit of the benefits that can be realised through renewable self-generation.</p>
Effective use of climate change projections			
There is currently no common approach to the use of the probabilistic functions of UKCP09. It is unclear what regulators will accept as robust justification for investment.	Provide a national approach for the use of UKCP09 so that the water industry can ensure it is working in alignment with other sectors.	Actively engage with the water industry to define a common approach to the use of UKCP09.	Continue to seek to work collaboratively with the industry to develop a consistent methodology for the use of UKCP09.

Enhancing future climate projections			
<p>Weather extremes are critical to the water industry in determining investment needs. UKCP09 is less confident in the extreme ranges of future projections.</p> <p>UKCP09 was published too late for thorough inclusion in the 2009 Price Review.</p> <p>It is unclear what future developments are planned for UK climate projections, making planning difficult.</p>	<p>We would welcome further research and focus on the extremes of climate change from UKCIP (and/or other organisations).</p> <p>We encourage any future releases of significant modelling developments to consider the water industry Price Review timescales in order to allow timely incorporation into our regulated investment activities.</p> <p>We seek clarity on future timescales of the development and enhancement of climate change modelling by UKCIP (and/or other organisations).</p>	<p>Continue to work collaboratively with the water industry and climate change data providers to ensure necessary developments that enable the water industry to act with confidence in preparing for climate change.</p>	<p>Continue to work collaboratively with the water industry and climate change data providers to ensure necessary developments that enable the water industry to act with confidence in preparing for climate change.</p>
Interdependencies – supply chain			
<p>Our extensive supply chain is critical to our ability to maintain our services to customers. At a national level, there may be difficulties in clarifying roles and responsibilities.</p>	<p>Provide mechanisms and forums that support organisations in considering their interdependencies and preparations. Clarify roles and responsibilities of organisations involved.</p>	<p>Work collaboratively with the water industry to consider interdependencies and make appropriate preparations.</p>	<p>We will work collaboratively with our supply chain to consider the interdependencies and how best to manage them to ensure a flexible and resilience approach.</p>

4.4. OUR APPROACH TO MANAGING CLIMATE CHANGE WITHIN THE REGULATORY FRAMEWORK

28. Our SDS sets out the aspirations for our business to the year 2035 and identified climate change as one of ten priorities. The SDS is discussed further in Section 1. The SDS outlined our plan to carry out strategic research to improve our understanding of how climate change will affect our infrastructure before revising design standards.
29. In our fifth AMP which runs from 2010 to 2015 (known as AMP5), we will invest in excess of £3 billion on operating, maintaining and improving the region's water and waste water infrastructure. The funding for this period was determined by Ofwat in 2009. This included investment which will support our preparations for climate change through research, investigations, modelling and building asset resilience (further details can be found in Section 6).

4.4.1. Sustainable adaptation

30. Our environmental policy recognises that the long term viability of our water and waste water business is dependent on sustainable operations. We believe sustainable operations are those that drive efficient resource use and provide a healthy environment, which in turn facilitate social progress and economic development. In our environmental policy we make a number of commitments, including one seeking to mitigate and adapt to the effects of climate change through innovative techniques and technologies.
31. There may be conflict between adaptation and mitigation response plans, for example where there is a need to build flood protection structures which could result in significant embedded carbon emissions. There may also be challenges ensuring economic sustainability, for example when considering how much current customers should pay for future protection of services or how much future bills might have to rise to maintain levels of service in the changing climate. Therefore, we will work within the regulatory regime to continue balancing customer service, customer bills, environmental improvements and returns for our investors in both the short and long term.

4.5. WORKING TOGETHER AND CONSULTATION

32. We recognise that we can not adapt effectively in isolation. As a large regional organisation, we have a significant number and wide variety of stakeholders. We have and will continue to work collaboratively with our stakeholders as we prepare for the changing climate. To prepare fully and effectively, it will be essential for a multi-agency, joined-up approach from all involved.

4.5.1. Customers

33. Our customers are at the heart of what we do. They help us determine the levels of service appropriate for our region. Ultimately, our customers fund our ability to deliver those services. As we discussed in Section 4.2, we will need to retain and build upon the support of our customers and the wider community if we are to respond effectively to climate change. However, as we highlighted in Section 4.4, there are questions over today's customer's willingness and ability to pay, to ensure service levels can be maintained into the future. We

believe this issue needs open debate and we will seek to work collaboratively with our industry and its regulators.

4.5.2. *The Government, regulators and the water industry*

34. As a regulated industry, the Government and our regulators direct many of our activities through their legislation, regulation and policy. It is critical for us, as an active part of the water industry, to continue working with the Government and our regulators to ensure legislation and regulation that supports effective the need to prepare for future climate change. We will continue to seek to work collaboratively with the Government and our regulators, both directly and through the industry body Water UK. We are active members of the Water UK groups for Climate Change and Carbon Management.

4.5.3. *Our supply chain*

35. We have a vast supply chain on which we depend for critical resources, such as chemicals, energy, fuels and IT. The recent harsh winters in early and late 2010 have highlighted some of the significant potential impacts that climatic extremes can have on our operations.
36. We recognise the need to consider further our supply chain implications to ensure sufficiently effective resilience to future climate change. We will be looking to work collaboratively with our supply chain to consider these interdependencies and how best to manage them. At a national level, there may be difficulties in clarifying roles and responsibilities and we therefore ask for government mechanisms that support considerations and preparations in this area.

4.5.4. *Research partners*

37. All organisations have a need to develop their knowledge and understanding of the impacts of climate change to their functions. We highlighted our need for strategic climate change research in our 2007 SDS. Since then, we have included our largest ever research and investigation budgets within our AMP5 business plan. Further details on this can be found in Section 6.
38. In addition to our own research and investigations, the water industry has worked collaboratively on research for many years, through UK Water Industry Research (UKWIR). A number of climate change related projects are already underway, and we will seek to ensure that more will continue in the future. Yorkshire Water will continue to work with and support UKWIR research.

4.5.5. *Other stakeholders*

39. Our organisation works at the heart of the Yorkshire and Humber region, so it is natural that we have a wide range of stakeholders. In relation to climate change and wider environmental matters, we have an ongoing engagement process with many of our key stakeholders through our independent Environmental Advisory Panel (EAP). We established this group many years ago in order to work effectively with a range of our key environmental stakeholders, including for example the EA, NE and RSPB.
40. We inform and/or consult our EAP on all environmental matters of importance to our business and have discussed climate change and carbon management with them on a number of occasions in recent years. Most recently, we reviewed our climate change

adaptation preparations with the EAP. We shared an overview of our current activities and understanding, and we facilitated an informative discussion to understand each others risks and preparations. This has started a process to better understand our interdependencies. We will continue to work with the EAP and other stakeholders in the future.

4.6. *CONCLUSIONS*

41. The water industry operates within a closely regulated framework focused around a Price Review every five years. As part of this process, the water companies set out robustly justified investment needs in their business plans and seek approval from Ofwat. The Price Review framework has served the industry and our customers well since privatisation. The framework can be developed further, for example, we believe there is an opportunity for an integrated, holistic approach to water cycle management, which will support our ability to respond to future climate change.
42. As a large, regional organisation we have a large number and wide variety of stakeholders with which we have adaptation interdependencies. We have started to engage with these stakeholders and we will continue to seek to work collaboratively in the future. In order to prepare fully and effectively, it will be essential for a multi-agency, joined-up approach from all involved.

5. CLIMATE CHANGE RISK ASSESSMENT

5.1. SECTION SUMMARY

- Yorkshire Water operates within its parent company's risk policy (Kelda Group). Our risk framework aligns with the revised risk policy and is founded on ISO 31000:2009
- Our aim is to have a risk neutral attitude to risk appraisal in order to continue balancing customer service, environmental improvements, customer bills and returns for our investors in both the short and long term
- Our approach to climate change risk management aligns with the UK Climate Impacts Programme (UKCIP) methodology
- Climate change is recognised as a strategic business risk on our risk registers
- Our risk assessments and business planning informed our fifth Asset Management Plan (AMP5). As a consequence, our Plan includes investment in asset resilience, network modelling and climate change research to support preparations for future climate change
- Our latest climate change risk assessment consider how the four general climate change trends projected for our region in the UK Climate Projections (UKCP09) scenarios (as described in Section 3) could impact our services. The scenario timescales align with our short, medium and long term planning requirements for climate change. This will be used to inform future planning and investment decisions which will be incorporated into the next Price Review and beyond
- We aim to develop quantitative risk assessments to assess climate change impact on our assets, networks and customer service
- Our future approach is iterative and flexible to respond to developing knowledge and the weather and climate we actually experience over the coming decades.

5.2. INTRODUCTION

43. Climate change and severe weather events directly influence our ability to operate effectively and maintain levels of services to customers. Climate change is one of ten long term priorities within our Strategic Direction Statement (SDS). Further details on our SDS can be found in Section 2.
44. Our strategic and business risk registers contain two risks relating to climate change and extreme weather:
 - A strategic risk of 'not taking appropriate regard of the potential/likely effects of climate change, with respect to adaptation specifically, with respect to water resources, sewer flooding, coastal erosion, energy management, water recycling, waste minimisation, and the effect of new research on changing regulations'

- A business risk of an 'inability to meet customer demands for water resources due to drought'. This is managed through our Water Resource Management Plan, which is discussed further in Section 6.
45. We view climate change risk management as an iterative process. We will continue to develop our understanding of how climate change will impact our overall infrastructure and customer services to inform our climate change risk assessments,
46. In this section we focus on our risk management approach, with specific regard to climate change adaptation, including:
- Yorkshire Water risk assessment methodology as part of the Kelda Group of Companies
 - Our latest cross business climate change risk assessment.

5.3. *THE DEVELOPMENT OF RISK ASSESSMENT IN YORKSHIRE WATER*

47. Over the last fifteen years, we have developed and continually enhanced our risk management capability. We have consistently pushed the boundaries of industry best practice and embedded this as a 'business as usual' approach.
48. Our significant leap forward came in time for the 2004 Price Review (PR04) when the development of risk based, service orientated, cost benefit analysis tools were used to ensure we planned on the basis of "maximising the service from every pound we spend on our assets".
49. For the last Price Review in 2009 (PR09) we further developed our Leading Edge Asset Decisions Assessment (LEADA+) process which illustrates our drive for continuous improvement. This process is fully compliant with the requirements of the UK Water Industry Research (UKWIR) Capital Maintenance Planning Common Framework cost benefit approach.
50. Below, Figure 4 summarises the process of risk based asset management change and implementation over recent years.

Figure 4 – The development of our risk management approach

1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2009
Asset Management Plan 2					Asset Management Plan 3					Asset Management Plan 4				
<p>Moved away from condition based asset management plan.</p> <p>Developed the concept of 'risk of loss of service' and risk based prioritisation of investment.</p> <p>Implemented these concepts in time for the 1999 Price Review, leading to a stepped change in our planning capabilities.</p> <p>Assessed as best in the industry.</p>					<p>Implemented our 1999 Price Review risk based approach to asset management planning for day to day running of the business.</p> <p>Developed cost benefit approach to programme management, integrating asset management, risk management, customer priorities, investment planning and business strategy (LEADA) and incorporating:</p> <ul style="list-style-type: none"> • One corporate risk based approach • Full economic Cost Benefit • Willingness to Pay studies • Asset deterioration modelling • Discounted cash flow (NPC) • Corporate applications. <p>Assessed as best in the industry.</p>					<p>Fully embedded LEADA as 'business as usual' for the delivery of the AMP5 programme.</p> <p>Significantly up-skilled our people to maximise the benefit of LEADA implementation.</p> <p>Developed LEADA+ in our drive for continuous improvement, and building upon our 'business as usual' experience to keep the 'Leading Edge' in LEADA. Improvements incorporate:</p> <ul style="list-style-type: none"> • Inter-temporal optimisation • Risk aggregation & service loss • Real Whole Life Cost decisions • Infrastructure assessed at pipe level • Four years of operational application. 				

51. We assess the risks to service delivery by collecting and analysing data on above and below ground assets, as well as extreme event related incidents. The data collected allows us to identify the probability of customer service failure at given points in time using appropriate mathematical distributions. This enables us to identify current and future risks to service.
52. We assess risk of loss of service across all areas of the business as a function of:
- Probability of asset failure
 - Probability of failure causing a defined customer service impact
 - Severity of the impact on customer service
 - Quantity or scale of the impact.
53. Our two stage probability assessment helps asset managers think separately about the asset failing and the subsequent impact on customers. This has improved the understanding of probability assessments and appreciation that assets can fail without causing direct or immediate service impact.
54. As part of the business as usual application of this methodology we utilise a five by five matrix to help visualise the pre and post risk treatment positions. This matrix, shown in Figure 5, is embedded within a corporate application, known as the Business Risk Model (BRM), which ensures consistency of approach across the whole business.

Figure 5 – Business Risk Matrix

PROBABILITY	IMPACT				
	VL	L	M	H	VH
	VH				
	H				
	M				
	L				
	VL				

55. Our corporate applications to identify, quantify, prioritise and mitigate risks to levels of service are connected and form part of a business as usual process. A key part of this connectivity is the link to our asset inventory, and availability of information to our service delivery partners.
56. By understanding the risks posed to service delivery in a consistent way across the business, we are able to understand and evaluate the risk climate change adaptation poses, against other risks identified in the business.

5.4. OUR RISK MANAGEMENT POLICY AND FRAMEWORK

57. We work within our parent company's risk policy and management framework (Kelda Group). This means that all risks, including climate change, at all levels, in all companies of the Kelda Group, are identified and managed consistently following the same best practice process.
58. The Kelda risk policy and management framework was reviewed in 2010 and aligned with the ISO 31000:2009 risk management standard published in November 2009 and the UKCIP adaptation risk process. It is a cause – event – impact approach.

Figure 6 – Kelda Group climate change adaptation risk assessment process

ISO31000 and YW risk step	Establish context & objectives	Define risk appetite	Risk identification	Risk analysis	Risk evaluation	Risk treatment	Monitor residual risk	Review & report residual risk
Integrated Kelda / UKCIP framework	Identify & define problem & objective	Establish your risk tolerance level and decision-making criteria	Identify & assess risks & opportunities	Identify adaptation options	Appraise your adaptation options	Decide and implement decision	Monitor residual risks at agreed frequency	Report to key stakeholders through Kelda Risk Management Forum

59. Our approach requires that all types of risk are managed at all business levels dependent on the nature and severity of the risk. Climate change risks could appear at any management level and as such climate change is treated the same way and in conjunction with other risks.

60. We have defined four risk levels within our framework:

- **Strategic Risk** is defined as any risk which, should it occur, would result in a very high impact on the operation and survival of our Company as a whole. A strategic risk could be a single risk which may have escalated because of a change in our operating environment, or an amalgamation of risks which should they all occur would have a very high impact.
- **Business Risks** are high level risks which have direct impact on our medium and long term objectives, again these could be escalated or amalgamated risks from the levels below.
- **Operational Risks** are risks which impact on our day to day operations and the ability to deliver short term goals.
- **Programme/Project Risk** relate to any risks which have an impact on the delivery of a programme of work or a single project. Risks relating to programmes of work or projects being delivered by Capital Partners are the responsibility of these Partners.

61. Both strategic and business risks are recorded on our business risk register and are managed through the Control Risk Self Assessment (CRSA) process outlined below.

Figure 7 – Risk management levels and responsibilities



62. The Turnbull Report ('Internal Control: Guidance for Directors on the Combined Code') sets the standard for good corporate governance across public and private sectors (Financial Reporting Council, 2005). The Report describes CRSA which forms an integral part of our strategic and business risk management process and provides our Board assurance that risks are effectively managed, monitored and reviewed.

63. The CRSA process allows business unit leaders to participate in assessing and reviewing the risks assigned to their business area. This permits them to clarify business objectives, identify the risks to achieving those objectives and agree effective treatments to these risks. The process stages are:
- Monthly - facilitated, workshops are undertaken to review business risks and associated treatments/controls for each leadership team. New risks are identified, existing risks re-assessed, appropriate risk owners assigned and the effectiveness of existing risk treatments assessed and changed if necessary
 - Quarterly - workshops are undertaken by our Directors to review and assess strategic risks and the effectiveness of controls to them
 - Annually - Directors sign off of their directorate's risk assessments and management plans as acceptable.
64. The CRSA process provides a robust challenge and consistency across the Kelda Group in the identification and assessment of risk and the selection of appropriate treatment options.
65. The identification of risks is undertaken at every business level, from individual employee to Board, making use of historical data, expert opinion and knowledge, stakeholder input and theoretical analysis to help identify the probable causes and potential consequences of risk for Yorkshire Water.

5.4.1. Risk tolerance and decision making criteria

66. Understanding the risk attitudes helps define the risk criteria which determine acceptable risk levels and facilitate decision making. The levels of risk attitude are:
- Paranoid - misplaced over concern about risk
 - Averse - requires considerable incentive to take risk
 - Tolerant - accepts risk as part of the business
 - Neutral - considers benefits and losses and if the benefits outweigh losses, will take the risk
 - Seeking - requires little incentive to take risk
 - Addicted - requires no incentive to take risk.
67. The risk attitudes of colleagues assessing climate change adaptation risks are being determined as part of our latest climate change risk assessment process.
68. Our aim is to have a risk neutral attitude to risk appraisal, as our Board believe this is the best approach to balance the needs of the business with those of customers, stakeholders and regulators. The risk attitudes of colleagues assessing climate change struck an appropriate overall balance of being risk neutral.

5.5. *EMBEDDING CLIMATE CHANGE RISK MANAGEMENT AT YORKSHIRE WATER*

69. We undertook a cross business asset based qualitative risk assessment in 2008. Our approach was based on a Water UK tool which was designed to help consider climate change risks and adaptation response measures. The assessment helped us to develop our understanding of our potential risks from climate change and it is the foundation for climate change risk assessment across Yorkshire Water.
70. Our strategic and business risk registers contain two risks relating to climate and weather events. The first is a business risk described as an 'inability to meet customer demands for water resources due to drought' which is managed through our Water Resource Management Plan (WRMP) discussed in Section 6. The second is a strategic risk described as 'not taking appropriate regard of the potential/likely effects of climate change, with respect to adaptation specifically with respect to water resources, sewer flooding, coastal erosion, energy management, water recycling, waste minimisation, and the effect of new research on changing regulations'.
71. The work in 2008 demonstrated the inherent uncertainties in climate change risk evaluation, and in particular, accurately assessing probability and impact. Our AMP5 research and modelling programmes will investigate and model asset performance to help develop our understanding of thresholds, likelihood, probability and the consequences in terms of severity and quantity of customer service impacts. Further detail can be found in Section 6.
72. Our aim is to develop quantitative risk assessments for climate change adaptation. This is important because we are a regulated business and must have the ability to identify, quantify and manage many types of risk whilst balancing customer and stakeholder needs within the regulatory requirements. Further details about the regulatory framework can be found in Section 4.

5.5.1. *Our current climate change risk assessment*

73. We are currently undertaking a second programme of climate change risk assessment to re-examine risks in light of changes since 2008. These changes include:
 - The release of UKCP09
 - The 2010 review of the Kelda risk framework (described above)
 - Our developing knowledge and understanding gained through our own and other research, for example an independent review of our adaptation research and development needs, carried out on our behalf by Cranfield University.
74. This programme is following a qualitative, Delphi approach with assessments based on the UKCP09 scenarios for Yorkshire and Humberside. Our initial probability and impact assessments are generally experience based and subjective. Through our iterative approach, the results of our current approach will prioritise further work.

75. We have chosen to focus on three main timescales to assess the risks relating to climate change projections:
- **Short term – 2015 to 2020.** This aligns with our next (sixth) regulated business planning phase, known as AMP6. This is our next opportunity to secure regulatory approval for any new adaptation investment that may be required. Business plans will be submitted for regulatory approval in 2014
 - **Medium term – 2035.** This aligns with our 25 year strategic planning period
 - **Long term – 2080s.** This aligns with the latest available time frame in UKCP09 projections, and at which point some of our assets are likely to still be in use.
76. We are considering how the four general climate change trends projected for our region in UKCP09 scenarios (as described in Section 3) could impact our services, these being:
- Hotter, drier summers
 - Wetter, milder winters
 - Sea level rise
 - An increase in extreme events.
77. We are examining risks to each main stage of our operational water lifecycle, from source to tap and sink to river. The stages we follow are:
- Water resource management
 - Water treatment
 - Water networks
 - Customer service
 - Waste water networks
 - Waste water treatment
 - Sludge treatment and disposal
 - Cross business support services.
78. A summary of our developing second climate change risk assessment programme can be found in the following pages. We have structured the summary using an edited version of the headings from the table in question six of the Defra Executive Summary template (found in Appendix 2). In this way, we aim to provide the level of detail required by Defra, in a suitable format to allow production of the national Climate Change Risk Assessment.
79. Our approach will evolve as we continue to develop our knowledge and technical understanding. Our current activities will support our aim to develop quantitative risk assessments for climate change adaptation. This will be used to inform future planning and investment decisions which will be incorporated into the next Price Review and beyond.

80. We have identified a number of risks which are generic to all of our business functions, relating to asset damage, site access and management information:

- Loss of assets by flooding by the sea, tidal surge, breached flood defences, pluvial, fluvial and groundwater flooding
- Supply chain impacts, for example by loss of power due to generation or transmission damage
- Higher and lower average and peak temperatures affect equipment, structures, buildings and plant, causing accelerated asset deterioration
- Severe weather prevents access, repair, maintenance and re-supply
- Severe weather damages instrumentation
- Power loss interrupts management data flow
- Power loss damages instrumentation
- Prolonged severe frost damage to assets and pipes
- Ability for staff to travel to and from work, and in between sites
- Staff illness.

BUSINESS FUNCTION: WATER RESOURCE MANAGEMENT

Service priorities in the regulatory framework

- Adequate water resources to meet demand (EA Water Resources Management Plan and Ofwat reporting in the June return)
- Reduce risk of hosepipe restrictions (Ofwat measure DG4)
- Environmental protection (EA abstraction licence requirements).

Our strategic priorities

- Ensuring there is never a need for water supply restrictions
- Mitigating our carbon footprint & adapting to climate change.

Primary impacts of climate variable

(Strong links and overlap with the Water Treatment and Water Networks functions)

Demand

- Daily and annual demand increases
- Redistribution or an increase in tourism increases seasonal demand
- Relocation of permanent population and businesses may change demand
- Summer peak demands exceed abstraction and treatment capacity
- Winter peak demands exceed abstraction and treatment capacity due to bursts.

Supply

- Reduction in water resource yield
- Tighter abstraction licence condition due to poor environmental quality, eg higher protected river flows reduces yields
- Sea level impacts on estuarine water quality and reduces summer abstraction and yield
- Increased evaporation and evapotranspiration reduce yields
- Multi-year droughts exceed system design
- Increased erosion causes the siltation of dams, causing accelerated asset deterioration and storage loss
- Groundwater saline intrusion reduces yield
- Potential increase in water resource availability in Winter.

Threshold(s) above which this will affect your organisation. Likelihood of threshold(s) being exceeded in the future. Confidence in the assessment.

Our water resource planning is based on the following levels of service and our water supply network is designed to deliver these standards:

Restriction	Minimum frequency of restriction
Hosepipe	1 year in 25
Drought Order Implementation	1 year in 80
Rotacuts / standpipes	1 year in 500

We manage an effective supply and demand balance for the short and long terms. In the short term, our real time Water Resources Allocation Plan (rtWRAP) system supports our ability to continually monitor and respond to customer demand. In addition, our regional grid network provides us with a highly flexible system that enables us to move water around our region to maintain effective services.

For the longer term, we analyse future pressures and consider a variety of options available to reduce demand and/or increase supply. Our analysis is reported publicly in our Water Resources Management Plan (WRMP). Our latest plan showed no supply-demand issues in the next 25 years in the Yorkshire region. Our assessment was in line with EA regulatory requirements and used the latest climate change projections available (UKCIP02-WaterUK 2006 methodology and a provisional UKCP09 assessment). We have high confidence in our current plan.

Water resource planning never remains static and weather events in recent years have shown that extreme events such as multi-year droughts can test our resource capabilities. Therefore, our WRMP is revised every five years and reviewed on an annual basis, in order to ensure continued effective management activities and to highlight any investment needs. Our WRMP assessments use the best available climate change projection data available to us, alongside information about other pressures on water supply and demand, such as population growth and business demand.

Potential impacts on organisation and stakeholders

Organisation:

We will continue to incorporate the latest climate change projections into our WRMPs, as described above. In the longer term, projected climate change may impact sufficiently in combination with other pressures to justify new management approaches and/or new investment to effectively maintain the supply and demand balance. Any such investment will be rigorously assessed and considered through the water industry regulatory Price Review process.

Stakeholders:

Customers are at the heart of our activities as a water service provider. We recognise the need to continue developing our and their understanding about the true value of water in order to reduce consumption. We must retain and build upon the support of our customers and the wider community if we are to respond effectively to climate change. For example, it may be necessary to seek funding (through customer bills) for additional resources and approaches to ensure we can maintain an effective supply and demand balance.

Water companies and regulators will need to work together to ensure appropriate levels of investment and arrangements for licensing that balance supply and demand needs, environmental protection and customer bills.

Proposed action to mitigate impact

In the short term, rtWRAP and our flexible grid system are used for day to day management. Contingency and escalation plans are in place for extreme events. In the longer term, the WRMP process ensures regular review of the supply and demand balance, and effectively considers required management responses, with any investment needs to be agreed with the regulator each Price Review.

As a society, there is a need for education about the true value of water and the need to conserve it. We seek to work in collaboration with others to deliver such education programmes. We already do work in this area, in AMP5 we have an annual water efficiency target of two mega litres per day (Ml/d). We aim to meet this target through provision of advice and promotion of water saving equipment.

Timescale over which risks are expected to materialise and action is planned

The WRMP covers a 25 year period. The plan is reviewed annually with regulatory processes in place should a need for additional management approaches be identified in the future.

BUSINESS FUNCTION: WATER TREATMENT

Service priorities in the regulatory framework

- Safe, wholesome drinking water (DWI water quality standards and reporting).

Our strategic priorities

- Delivering the very best drinking water quality
- Ensuring there is never a need for water supply restrictions
- Mitigating our carbon footprint & adapting to climate change.

Primary impacts of climate variable

(Strong links and overlap with the Water Resources and Water Networks functions)

Raw water quality

- Storm events increase pollutants beyond works design capacity or treatment stages, for example nitrates and pesticides.
- Lower river flow rates reduce raw water quality/increase contaminate concentrations beyond works design capacity or treatment stages, for example increase in ratio of sewage effluent caused by drier Summers
- Changes in stability of the catchment leads to high turbidity which inhibits treatment efficiency
- High Summer temperatures or fire cause moorland colour generation which can be transported by Autumn rainfall to increase colour load beyond water treatment works design capacity
- Increased algal growth taint causing treatability issues
- Increased residual chlorine depletion or trihalomethane (THM) generation may cause failure of drinking water standards
- Increase in salinity due to rises in sea level
- Water treatment works discharge consent standards raised due to lower environmental quality.

Threshold(s) above which this will affect your organisation. Likelihood of threshold(s) being exceeded in the future. Confidence in the assessment.

Our standards for water treatment are set by the extensive list of drinking water parameters which are available on our website at www.yorkshirewater.com.

Raw water quality is currently managed through existing environmental regulation and voluntary initiatives. Source selection is optimised according to prevailing water quality and resource availability.

The flexibility of our supply network allows the optimisation of water treatment plants to produce safe and compliant water quality under varying water quality and resource constraints.

Using a Water Safety Plan approach, changes in risk to the production of safe and compliant water are continually identified and assessed.

Raw water quality is monitored via on-line instrumentation and a risk-based sampling programme. Treatment is matched to the source characteristics. Treatment performance is continuously monitored and optimised to meet existing compliance standards. Trending of certain parameters over short, medium and long term periods allows us to identify future risks to compliance. The existing Price Review process is used to plan for the necessary improvements in treatment capability to ensure future compliance standards are met.

Potential impacts on organisation and stakeholders

Organisation:

The extent and speed of changes in raw water quality as a result of climate change may necessitate additional water quality monitoring, treatment facilities and/or raw water management practices to ensure safe and compliant drinking water production. Any such investment will be rigorously assessed and considered through the water industry regulatory Price Review process.

Stakeholders:

There is no observable direct impact to customers because of our robust management approach and the strongly regulated approach to compliance failure. It may become increasingly challenging to maintain levels of service in the changing climate.

There is potential for increased collaboration with environmental stakeholders to promote and implement good catchment management practice, for example working with the National Farmers Union (NFU), our agricultural tenants, other landowners, Natural England, and the EA.

Water companies and regulators will need to work together to ensure appropriate levels of investment in integrated catchment management, treatment, distribution network and environmental protection.

Proposed action to mitigate impact

We will continue to use our infrastructure and extensive operational management procedures to monitor and assess changes in raw water quality and its subsequent treatability impact. Any investment needs will be agreed with the regulator at each Price Review.

Timescale over which risks are expected to materialise and action is planned

We effectively manage water quality issues today. Climate change may enhance the deterioration. Water quality issues can develop over time or as an acute event. Our management regime is mature and strictly regulated by the DWI.

BUSINESS FUNCTION: WATER NETWORKS

Service priorities in the regulatory framework

- Avoid low pressure supply issues (Ofwat measure DG2)
- Avoid unplanned interruptions (Ofwat measure DG3)
- Minimise leakage (Ofwat OPA measures)
- Safe, wholesome drinking water (DWI water quality standards and reporting).

Our strategic priorities

- Providing a customer experience second to none (zero interruptions - our principle for all assets is for 'invisible operations - visible service')
- Reducing leakage significantly (halve existing levels of leakage)
- Ensure there is never a need for water supply restrictions
- Delivering the very best drinking water quality
- Mitigating our carbon footprint & adapting to climate change.

Primary impacts of climate variable

(Strong links and overlap with the Water Resources and Water Treatment functions)

Water distribution

- Peaks of demand greater than hydraulic capacity of distribution system
- Extreme weather affects different pipe materials in different ways. Potential increase in damage to buried pipes due to:
 - Prolonged subzero temperatures (frozen pipes)
 - Extreme hot or cold weather increasing subsurface instability (cracked pipes)
 - Temperature changes causing thermal expansion and contraction
- High temperatures can affect water quality, such as chlorine residuals
- Loss of / intermittent and peak demand supply increases risk of contamination from accumulated silt and debris being flushed out of service reservoirs and towers
- Loss of supply and de-pressurisation of pipelines leads to greater incidence of pipe failure, and potential contamination during re-pressurisation.

Threshold(s) above which this will affect your organisation. Likelihood of threshold(s) being exceeded in the future. Confidence in the assessment.

Water mains are required to be located at least 0.75 metres below the surface.

Climate change scenarios (UKCP09) suggest that there may be significant changes in temperature, the distribution and duration of summer and winter rainfall, as well as periods of drought. This is of particular relevance to the way in which the varying ground conditions will influence the movement, cracking and alignment of the water mains, leading to increases in burst rates.

Potential impacts on organisation and stakeholders

Organisation: The impact and adaptation to climate change relates to one of our SDS priorities, but it also contributes to several of the other SDS priorities. These include reducing leakage, ensuring there are no water supply restrictions, zero interruptions and zero pollution incidents. We will have to proactively adapt our network to ensure these SDS aspirations are not affected by climate change.

There may be increased pressure on the environment in terms of the way we install our water mains e.g. digging deeper excavations. The locations in which we install new mains may also change to help address climate change risks.

Stakeholders:

We will continue to engage with customers so that they are aware of the reasons for potential modifications to the water network in response to climate change. Additional funding may be required to reduce the risk of asset failure due to climate change.

Water companies and regulators will need to work closely together to understand the impacts of climate change and how this will affect customers, in terms of bills, service and the quality of water they receive. The regulators will also have to work closely with, and support, water companies in terms of research and innovation to provide solutions to the issues that climate change may bring to water networks.

Proposed action to mitigate impact

In the short term, we will continue to manage the network to ensure our customers get the best service possible, whilst also meeting our regulatory requirements. For periods of extreme weather, we will use our current contingency and escalation plans.

In the medium to long term, we will grow our understanding of climate change and its potential implications. This will include continual research into the implications of climate change on the water network, as well as utilising relevant knowledge from external bodies.

The business cases developed for future Price Reviews will include climate change as part of the criteria on which an investment case is built.

Timescale over which risks are expected to materialise and action is planned

Over the last 3 years the extremely cold winters have meant that we have faced a challenging time managing the water network to maintain leakage at an economic level and the burst rate at a stable level. This has, in turn, had an impact upon the service provided to our customers. The experience of these winter events, as well as the dry summers in between, has enabled improvement of our understanding about the impacts of extreme weather events upon our water network.

BUSINESS FUNCTION: CUSTOMER INTERFACE

Service priorities in the regulatory framework

- Excellent customer service (Ofwat Service Incentive Mechanism, SIM; and Ofwat DG measures No 6, 7, 8 & 9; and CCwater objectives. Plus the other measures outlined under the other business functions)

Our strategic priorities

- Providing a customer experience second to none
- Delivering the very best drinking water quality
- Ensuring there is never a need for water supply restrictions
- Stopping our sewers flooding homes and businesses
- Providing tailored services for customers
- Providing the lowest possible prices.

Primary impacts of climate variable

(Strong links and overlap with all other business functions)

- Potential interruptions to our services due to an increase in damage to our assets and obstacles to effective operational practices.

Threshold(s) above which this will affect your organisation. Likelihood of threshold(s) being exceeded in the future. Confidence in the assessment.

Relevant standards within the regulatory framework:

Guaranteed Standards of Service (GSS)

These standards are the promises we make to our customers relating to the service they receive. By law we must meet these standards. We also add to these standards and enhance the minimum requirements. Failure to meet them results in payment being made to customers.

The standards include:

- Keeping appointments
- Responding to complaints, account queries and requests for payment arrangements
- Notification of interruptions to supply
- Restoring water supplies on time
- Meeting pressure standards
- Incidents of sewer flooding.

The Service Incentive Mechanism (SIM)

- Minimum volumes of:
 - Busy / abandoned calls
 - Unwanted calls
 - Written complaints
- A maximum satisfaction score out of 5.

We must report the volume of written complaints, abandoned/busy calls and the number of unwanted calls (quantitative measure). Ofwat also survey a sample of our customers who have had a resolved contact with us. The average satisfaction score is calculated based on the respondents' results (qualitative measure).

The quantitative and qualitative measures are combined to give one overall score that is ranked against other companies' scores.

Significant events will result in increased contacts as customers will have the need for timely information relating to their operational issue. Providing information is essential to assist customers and to provide a high level of customer satisfaction.

Potential impacts on organisation and stakeholders

There may be problems with staff unable to travel to work, or between sites, in extreme weather. In these events, human resources can be re-deployed. This will help maintain the service to customers effected.

The water companies and regulators will need to work collaboratively to engage with customers about contact strategies.

Proposed action to mitigate impact

Extreme weather can result in peaks in contacts and stretch resources. A strategy of proactive communications and promotion of self-service will reduce peak demands.

Our Call Centre staff are multi-skilled which allows for flexible resourcing.

We have contingency plans in place to help resource increased demand and focus on core services.

We will offer customers choices on how they interact with us to fulfil their need for information and action.

Timescale over which risks are expected to materialise and action is planned

Our contact strategies are evolving. New technologies offer great opportunities to meet future challenges. There is a risk of customer impact now and we are developing our mitigating actions to account for more frequent events.

BUSINESS FUNCTION: WASTE WATER NETWORKS

Service priorities in the regulatory framework

- Avoid flooding properties and external areas through overloaded sewers or other causes (Ofwat measure DG5)
- Environmental protection (EA discharge consent requirements and Ofwat reporting in the June return)
- Customer service related to blockages and odour problems (Ofwat SIM measure and reporting in the June return).

Our strategic priorities

- Stopping our sewers flooding homes and businesses
- Going beyond environmental compliance (Zero pollution incidents)
- Mitigating our carbon footprint & adapting to climate change.

Primary impacts of climate variable

(Strong links and overlap with the Waste Water Treatment function)

Demand

- Redistribution or an increase in tourism may change seasonal demand
- Relocation of permanent population and businesses may change demand
- Lower precipitation, infiltration & inflow and water conservation lead to lower average and peak 'carry' flows, resulting in greater sewer deposits and more frequent blockages, causing customer flooding
- Increased volumes of storm water from higher rainfall and rainfall intensities lead to runoff in combined sewers which exceeds sewer capacity, causes flooding and reduces receiving water quality
- High rainfall and high tides coinciding causes increased customer flooding and reduces receiving water quality
- Lower average and peak 'carry' flows lead to settlement in the system, affecting pumping regimes and causing accelerated asset deterioration
- Increased levels of septicity affect pumping regimes and cause accelerated asset deterioration and increased odour
- Higher temperatures lead to greater microbial action, and increased gas production and risk of ignition

Threshold(s) above which this will affect your organisation. Likelihood of threshold(s) being exceeded in the future. Confidence in the assessment.

We currently design our network to provide protection against flooding during a 1 in 30 year rainfall event. Our performance against this design standard is measured by Ofwat. Current thinking within the industry, supported by UKCP09, indicates that this current standard will not provide the same level of protection in the changing climate of the future. In order to consider and manage this effectively we recognise the need to better understand the operation of our networks and changing rainfall patterns. Therefore, we are undertaking strategic research into the effects of climate change on our overall infrastructure before revising design standards. Further detail on this can be found in Section 6.

Potential impacts on organisation and stakeholders

Organisation:

Climate change may have significant impacts on our waste water network. Current design standards will need to be reviewed periodically to ensure that levels of service protection are being maintained into the changing climate. In the short term, we will continue to grow our understanding of climate change and its impact on our networks. In the longer term, we will need to work with the rest of the industry to consider our modelling methodologies and design standards.

Stakeholders:

It is essential that we continue to engage with customers and secure their support. We will continue to work with our customers to manage property and area flood risks which result from our assets and operations.

There is the potential for increased pressure to the environment because lower river flows and higher temperatures may compromise water quality and increase the impact of any network discharges. This may result in a need to manage our discharges at a catchment level and with regard to spill volumes rather than the present regulatory framework which is driven by the amount of flows retained within the system.

Water companies and regulators will need to work together to ensure appropriate levels of investment are available to meet appropriate design standards which maintain or enhance service protection to customers. There will also be an increasing need to think more innovatively about integrated water cycle management and the management of excessive flows through more sensitive urban designs which incorporate Sustainable Urban Drainage solutions (SUDs). There may be opportunities to consider innovative approaches to discharge consenting which balance the needs of a secure supply-demand balance, environmental protection and affordable customer bills. With our expertise and asset base, we feel that we may be able to provide a greater role in a more integrated approach to water cycle management in the UK.

Proposed action to mitigate impact

In the short term, we will continue to manage our waste water network to maintain customer service. This approach includes the use of contingency and escalation plans to respond to extreme weather events.

In the longer term, we will continue to grow our understanding of climate change and its impact on our networks. We are increasing our asset management capability by undertaking a significant programme of Drainage Area Planning (DAP) which includes modelling of our surface water sewers. These plans can be used to help us understand how our network will respond to changing weather patterns. We also seek to continue working collaboratively with the rest of the industry to ensure that rainfall generating software used in our network modelling incorporates changing trends and is updated regularly.

As a society we need to develop our understanding of the most effective ways to manage high intensity rainfall events. We recognise that it is becoming less cost effective to manage excess flows beneath the surface and we will work to increase the acceptability of carefully considered and managed overland flood routing and water sensitive urban design.

Timescale over which risks are expected to materialise and action is planned

In recent years the country and our region has experienced numerous extreme rainfall events, and the massive disruption that this can cause. As knowledge continues to develop, we and other stakeholders will be better able to consider the detailed impacts of the changing climate and how best to respond. We are taking significant steps towards the development of the required knowledge with our plan to develop complete Drainage Area Plan coverage of our network, to our revised specification by 2035. We have started this programme, with prioritised zones being investigated this AMP.

BUSINESS FUNCTION: WASTE WATER TREATMENT

Service priorities in the regulatory framework

- Protect human health and the environment
- Ensure discharges and site operations are compliant with their permits
- Minimise nuisance from our assets (e.g. flies, odour)
- Reduce our energy consumption year on year.

Our strategic priorities

- Going beyond environmental compliance (zero sample failures / pollution incidents)
- Mitigating our carbon footprint & adapting to climate change.

Primary impacts of climate variable

(Strong links and overlap with the Waste Water Networks and Sludge Treatment functions)

Waste water treatment

- Redistribution or an increase in tourism may change seasonal demand
- Relocation of permanent population and businesses may change demand
- Extreme temperatures impact on biological treatment processes and pumping requirements
- Reduced oxygen saturation as water temperature increases, increasing the risk of a consent failure/pollution incident
- Discharge consent standards tighten to meet temperature-affected Water Quality Objectives, increasing the risk of a consent failures and/or pollution incidents
- Increased levels of septicity lead to increased toxicity, reducing receiving water quality and increasing odour
- Higher peak levels at the discharge change outfall hydraulics.

Threshold(s) above which this will affect your organisation. Likelihood of threshold(s) being exceeded in the future. Confidence in the assessment.

Relevant standards within the regulatory framework:

The regulatory framework sets site specific discharge consents (for the aquatic and atmospheric environments). For example, waste water treatment works effluent discharge consents often include parameters for Biological Oxygen Demand (BOD), Suspended Solids and Ammonia.

We have robust operational practices, supported through Quality Management System procedures, which ensure discharge consent compliance.

Potential impacts on organisation and stakeholders

Organisation:

The extent and speed of changes in environmental quality standards as a result of climate change may necessitate additional treatment facilities and/or management practices to ensure safe and compliant discharges to the natural environment. Any such investment will be rigorously assessed and considered through the water industry regulatory Price Review process.

Stakeholders:

There is no observable direct impact to customers because of our robust management approach and the strongly regulated approach to compliance failure. It may become increasingly challenging to maintain levels of service in the changing climate.

Water companies and regulators will need to work together to ensure appropriate levels of investment in integrated catchment management, treatment, sewerage network and environmental protection.

Water companies and regulators will need to work in collaboration to address the potential for more regular and widespread occurrence of conditions which are covered by consent waivers (eg flooding, cold weather, snow impacts).

Proposed action to mitigate impact

Over the last few years we have experienced extreme flooding, low temperature and significant snow events. The response to these has been reviewed and our escalation / response procedures improved accordingly.

The business cases developed for future Price Reviews will include climate change as part of the criteria on which an investment case is built.

Timescale over which risks are expected to materialise and action is planned

We effectively manage waste water quality issues today. Climate change may enhance the deterioration. Our management regime is mature and strictly regulated by the EA.

BUSINESS FUNCTION: SLUDGE TREATMENT AND DISPOSAL

Service priorities in the regulatory framework

- Environmental protection (EA waste permits and Ofwat reporting in the June return).

Our strategic priorities

- Going beyond environmental compliance
- Mitigating our carbon footprint & adapting to climate change.

Primary impacts of climate variable

(Strong links and overlap with the Waste Water Treatment function)

Sludge treatment

- Sludge reuse and disposal options might become more or less available/suitable. For example, new agricultural practices (eg new crop types) might be more or less suitable to sludge reuse in agriculture. Or, sea level rise may reduce the land available for reuse in agriculture
- Operational management practices may become easier or harder. For example, higher external temperatures may reduce the need for generated heat in the digestion process. The disruption of flooding and extreme events might damage assets or hinder normal management approaches. Wetter winters and drier summers may increase or reduce transportation requirements of the sludge product
- The drive to reduce carbon emissions and reduce use of fossil fuels is likely to encourage an increase in the sustainable energy that sewage sludge can be used to produce. It may also encourage farmers to increase their use of sewage sludge as a more sustainable alternative to fossil fuel derived fertilisers. We see this as a market opportunity
- Lower water flow increases concentration of toxic compounds in sludge, affecting sludge reuse and/or incineration and leading to waste disposal issues.

Threshold(s) above which this will affect your organisation. Likelihood of threshold(s) being exceeded in the future. Confidence in the assessment.

Relevant standards within the regulatory framework:

Code of Practice of the Agricultural Use of Sludge

The Safe Sludge Matrix (ADAS third edition 2001)

Potential impacts on organisation and stakeholders

Organisation:

Our sludge strategy is responsive to many external pressures to ensure it effectively balances environmental, economic and social sustainability. Our management systems will therefore help us adapt to respond to increasing pressures of climate change and to maximise any potential advantages.

The need for climate change mitigation and resilient energy supplies are among the drivers encouraging our increase in renewable energy recovered from sewage sludge. Uncertainty remains in the detailed impacts to our sludge treatment and disposal operations, therefore we recognise that further research is needed. Some examples of potential impacts may include an increasing challenge to ensure continued satisfactory sludge disposal and the need for more stockpile areas to increase to provide storage over the winter period when spreading is not possible.

Stakeholders:

The positive drive to maximise sustainable energy generation will increase the sustainability and resilience of our operations. This can also realise economic efficiency and further benefit customer through lower bills. Agricultural customers will be the primary group for consideration, with potential positive and negative impacts as outlined above.

Environmental protection in line with legislative and regulatory requirements will be assured through our management systems. Maintaining or enhancing levels of protection may become increasingly challenging in a changing climate, requiring new innovative approaches and technologies.

Collaboration between the water industry, its regulators and key stakeholders will enable maximum value to be taken from sewage sludge, for example through renewable energy generation and as an alternative fertiliser.

Proposed action to mitigate impact

Our sludge treatment and disposal strategy is helping mitigate the future impacts of climate change through increased self-generation and the provision of alternative products to traditional compost and fertilisers. Our increasing ability to generate our own electricity on site is also helping us adapt by improving the resilience of our assets against external disruptions. In addition, we are taking measures such as raising the height of control panels and key plant where the flood risks are known.

In the future, we aspire to maintain our record of zero unsatisfactory sludge disposals through our effective management systems, subject to available land for recycling of our treated sewage sludge. We recognise that climate change could pose significant impacts and that further research is therefore required.

Timescale over which risks are expected to materialise and action is planned

Most of the mitigation measures described above are already being put in place and our sludge strategy will continue to evolve with our understanding of the future impacts of climate change. Due to the inherent uncertainty it is not currently possible to state timescales over which the risks are expected to materialise, beyond an increasing risk with the increasing change shown in climate projections.

BUSINESS FUNCTION: CROSS BUSINESS SUPPORT SERVICES

Service priorities in the regulatory framework

- N/A.

Our strategic priority

- Providing a customer experience second to none
- Delivering the very best drinking water quality
- Ensure there is never a need for water supply restrictions
- Stopping our sewers flooding homes and businesses
- Providing tailored services for customers
- Providing the lowest possible prices
- Reducing leakage significantly
- Going beyond environmental compliance
- Mitigating our carbon footprint & adapting to climate change
- Delivering attractive returns for investors.

Primary impacts of climate variable

- Health, safety and wellbeing of staff
- Damage to assets and resources
- Disruption to transport and communication networks.

Threshold(s) above which this will affect your organisation. Likelihood of threshold(s) being exceeded in the future. Confidence in the assessment.

Relevant standards within the regulatory framework: N/A

Average trends in climate change over time are not anticipated to have any notable impact to support business functions beyond those which can be readily managed through general evolution in our working practices and standards. However, significant impacts may be seen from the projected increase in extreme weather events. If we look at the extreme events of recent years, such as the recent hard winter of 2010/11 or the floods of 2007, we can see the types of disruption this can cause.

Specific thresholds are difficult to identify. However, if we consider the various extreme events of recent years and assume that UKCP09 projections for an increase in such events are correct, then we can expect events which cause significant disruption on a reasonable frequency, perhaps every few years.

Potential impacts on organisation and stakeholders

Impacts to business support services will not normally directly affect core water and waste water services. However, the impacts could threaten the safety of our employees or could compound and/or hinder our ability to respond to direct impacts to core services (which may be occurring simultaneously).

Proposed action to mitigate impact

As we have described in Section 6, we have substantial contingency planning arrangements in place, including for extreme weather events. Therefore, we are well placed for these types of impacts. As part of our normal management approach, we regularly review and update working procedures and contingency plans to ensure employee safety and operational readiness. Climate change will be factored into this thinking.

Timescale over which risks are expected to materialise and action is planned

These risks are expected to evolve slowly over time, therefore our action and planning will also evolve over time.

5.6. *CONCLUSIONS*

81. The risk management framework and the qualitative assessments of the impacts of climate risks will evolve and develop over time to inform short, medium and long term planning. The outcomes of our work will feed future Price Reviews to ensure that an appropriate level of investment is identified for climate change, taking into account benefits for stakeholders and the impacts on our carbon footprint, to strike the right balance for Yorkshire.
82. Best practice is not a static goal, it is constantly evolving, as the environment in which companies operate changes and more innovative risk treatments and ways of working are found. Risk framework, policy and strategy will be under regular review.

6. OUR CURRENT ACTIVITIES TO BUILD ADAPTIVE CAPACITY

6.1. SECTION SUMMARY

- Our approach in response to climate change is embedded within our regulatory framework and remains focused on maintaining our high levels of service to customers. In this, our fifth regulatory period (known as Asset Management Plan 5, AMP5), a great deal of our investments and management activities will develop our adaptive capacity to support our long term approach to climate change
- In line with our Strategic Direction Statement (SDS) priority to adapt to climate change, we have our largest ever research and investigation programmes. Our activities will help us to start addressing the inherent uncertainty by developing our knowledge of the effects of climate change on our infrastructure and customer services. We will use applied science and our technical expertise of customer service implications to inform our planning at the next Price Review and beyond
- Water resource planning is an established strength of our organisation. We use a suite of models that can forecast our supply and demand needs and determine the most cost effective solutions to customer service implications. Climate change projections are embedded within this process
- We are significantly developing our other modelling functionality, of our sewerage and river networks. When we bring together all the advances we are making in our modelling capabilities, these tools will enable us to consider the impacts of climate change at every stage of the water cycle which we manage
- As part of our regulatory agreement at the last Price Review we also secured investment approval to enhance the resilience of our assets, including our treatment works and reservoirs
- We are highly experienced at managing services and assets during significant disruption from extreme weather events. We therefore have extensive contingency plans and arrangements which will become increasingly important in the changing climate.

6.2. INTRODUCTION – A CUSTOMER SERVICE APPROACH TO ADAPTATION

83. This chapter provides an overview of our activities in response to climate change. We recognise the need to consider both long term changes in climate trends and the resilience to extreme weather events. Both are essential in maintaining customer service.
84. The economic regulator of the water industry, Ofwat, encourages a customer focussed approach to operation, planning and investment. Our effectiveness as a service provider is measured in a variety of ways through our regulatory framework. The measures relevant to each of our core service functions are outlined in our high level risk assessment in Section 5. Our approach to climate change reflects this customer focus by considering individual assets and their network connectivity to determine customer service implications.

85. We are working in many areas that will support our ability to maintain levels of service in a changing climate. Our plans respond to current extreme weather events through investment in asset resilience of treatment and reservoir assets, and our contingency procedures. We are also responding to long term needs through our substantial research and investigation programmes which include significant modelling enhancements, all of which will help us understand the climate change impacts on our assets and customer services.

6.3. WATER RESOURCE PLANNING

86. The process of planning and managing water resources in Yorkshire is part of a fully integrated approach to operational planning from source to tap. Our primary objective is to ensure that secure, high quality water is supplied at minimum cost to customers whilst ensuring environmental protection. Climate change could impact on resource yields as well as customer demand. Therefore, climate change projections are fully integrated into our water resource planning methodology. As an area which is well versed in planning for a changing climate, we provide a case study below.

Planning for a changing climate in water resource management

Our Water Resources Allocation Plan (WRAP) suite of computer models are industry leading. We use real time systems linked to hydraulic models to plan weekly and daily water production to help us determine the best use of available resources to meet demand and maintain security of supplies. Our real time systems help us to respond to changing conditions in a timely and optimal way whilst considering financial cost, environmental impacts and energy use (carbon emissions).

Weather and climate change are among a number of factors which may affect the supply and demand balance by either increasing demand, or reducing supply over the short or long term. We use the water resources simulation software WRAPsim to model the effect of climate change on our supply system. We have a high degree of flexibility in our operations and can model both day to day and the long term. 95% of our customers are supplied by our interconnected Grid network. The conjunctive management system enables us to adjust our operations as required, making the system highly resilient.

To support our long term planning we have looked at trends of global, national and regional temperature data, and at river flow data for selected catchments in our region. We commissioned Lancaster University to assess the extent to which river flows in Yorkshire had already been affected by climate change. The results found no evidence for any statistically significant trend in flows in the analysed data, with the one exception of Summer period flows in the River Wharfe, which shows a decline in flows (Renata, *et al*, 2006).

We have also used a UK Water Industry Research (UKWIR) methodology to compare different methods of accounting for the impact of climate change on the water resources of our region. We found that climate change will result in an estimated decrease in deployable output (available water) of 54 Mega litres per day (Ml/d) in our grid surface water zone (which covers 95% of our customers) by 2025. This figure was used in our 25 year WRMP to inform supply and demand balance calculations. Overall, the deficit was in balance due to falling demand and therefore no action was necessary in AMP5.

In planning for our next formal WRMP we will continue: our investigations into climate change trends; developing our catchment models; and embedding the use of the 2009 climate projections (UKCP09). We will also follow closely the outputs of the joint Environment Agency (EA) and UKWIR projects looking at future river flows and the effect of UKCP09 projections on water resource planning.

6.4. IMPROVING ASSET RESILIENCE

87. There has been a significant regulatory response to the severe flooding events experienced by large parts of England in the Summer of 2007. While no single weather event can be said to be a result of climate change, it is widely accepted that climate change will lead to more frequent and more intensive storms. The Pitt Review of the Summer 2007 floods, highlighted that action must be taken to better assess and manage the long term threat in order to help avoid a repeat of the devastation caused (Pitt, 2008).
88. In June 2008, Ofwat produced guidance for asset protection against fluvial (river) and pluvial (surface water) inundation from flooding (available at www.Ofwat.gov.uk). A framework was developed to provide a consistent methodology for the industry to use in identifying those assets at risk of flooding which could lead to a service failure. In determining appropriate responses, the investment decision criteria include the use of Cost Benefit Analysis. The framework identified a range of assets that require investigation, modelling, pre and post solution probability thresholds, service failure and Failure Mode Effect Analysis.
89. At the last Price Review, in 2009, we secured regulatory approval for resilience investment. We are therefore currently delivering a programme to enhance the resilience of critical assets. We will use our developing knowledge and systems to consider the need for further resilience activities in our plans for the next Price Review.

6.4.1. Impounding reservoirs - Resilience to extreme rainfall events

90. We operate 140 Impounding Reservoirs subject to statutory obligations under the Reservoir Safety Act.
91. In our plans for the last Price Review, we reviewed spillway capacity and structural integrity for extreme rainfall events. In addition, a Quantitative Risk Assessment (QRA) was undertaken following the publication of the Interim Guide to Quantitative Risk Assessment (Defra, 2004).
92. For each reservoir dam, QRA quantifies the annual probability of failure and the consequences of failure of each dam. This was used to rank the dams which pose the greatest risk to third parties downstream, and also to quantify the overall risk posed by the reservoirs. Our response includes a range of measures dependant on the level of risk, including changes to surveillance frequency, changes to level of flood (emergency) plan, and financial investment in the infrastructure.
93. We have recently revised our threshold that would trigger investment to a 1 in 200 year rainfall event. We are currently assessing which of our reservoirs are at risk of failing in a rainfall event of this strength. Where investment is necessary to ensure this level of reservoir safety, any physical solution will be designed and built to provide protection up to a 1 in 1000 year rainfall event. This approach will increase the adaptive capacity of any such investment.

6.5. EMERGENCY PLANNING FOR EXTREME WEATHER EVENTS

94. The ability to manage and maintain customer service through periods of extreme weather will be an important aspect of adapting to climate change. We have thorough emergency response procedures embedded within our operations, and which meet legislative

requirements. Our regional control centre provides the central point for coordination of any incident. This is operated continuously, all year round. Incidents are managed using real time performance data and remote management controls.

95. We have an array of emergency plans to deal with the consequences of asset or service failure, such as alternative supply strategies, tankering, static tanks, bottled water. We also have the ability to call on analytical services, emergency equipment stores, bottled water stocks, mutual aid agreements, logistics contracts and multi-agency assistance. These plans include standards of service and make special provision for vulnerable customers and establishments.
96. Our procedures have been successful when tested during the very dry very summers, severe winter and summer floods of the last few years. We have also developed and enhanced our procedures in response to the valuable learning taken during such experiences.

6.5.1. Planning in response to the Security and Emergency Measures Direction (SEMD)

97. The water industry SEMD requires water companies to develop and maintain plans, and the facilities necessary for the implementation of those plans. The plans identify how we will ensure the provision of essential water and sewerage services in times of emergency. Each year the plans are externally audited on behalf of Defra.

6.5.2. Yorkshire Water's Incident Management Framework

98. We have a staged response to incident management to ensure resources and manpower is allocated effectively. Interruptions are categorised upon notification to help determine an appropriate management response. As necessary, different levels of management team will be established to implement plans and manage dynamically an unfolding emergency.
99. For example, a Company Risk Management Team (CRMT) was formed to manage the impacts of the severe winter during 2009/10. Ongoing travel disruption caused by snow and ice resulted in problems delivering water treatment chemical to sites. In response we have developed plans with highway authorities and service providers to maintain site access and draw on services outside of the company if conditions are prolonged.

6.5.3. Integrated emergency management

100. We work with the five Local Resilience Forums and the East Midlands Regional Forum and Yorkshire and Humberside Regional Forum. These cover our operational region to develop multi-agency plans. The Forums include the emergency services, local authorities, the EA and the NHS amongst others. This means that, for example, our standby rotas have been tailored to mirror Police command structures to support a more effective response. Forum members have been given site tours to increase their understanding of our business, what we can offer, and how we fit into resilience programmes. An integral part of integrated emergency management is the training and testing of plans, which we have played an active role in.

6.5.4. *Flood planning*

101. Flooding has a significant impact on our waste water network and treatment capability. As a consequence, we have prepared an escalation plan which responds to levels of warning received from the EA and calls from the public.
102. We are actively involved with multi-agency flood planning groups, such as Local Authority Resilience Forums and Flood Groups. We are engaging local forums and local authorities in the development of integrated plans arising from the Defra generic flood plan guidance. We continue to support the maintenance and exercising of these plans.

6.5.5. *Drought planning*

103. Our drought plan is integrated into our water resource planning to help us ensure that we can maintain secure supplies to all customers during drought periods. Droughts can be different in terms of location, extent, severity and impact on the supply system, so the drought plan is flexible and progressive to account for a range of possible scenarios. The plan provides a framework of drought response actions which can be effectively managed dependent on conditions. The plan has been approved by the Secretary of State for the Environment, Food and Rural Affairs, and it is integrated with the EA's Drought Plan.

6.6. *RESEARCH AND INVESTIGATIONS*

6.6.1. *Climate change research*

104. We secured significant funding for research and investigations in our current business plan. This included budgets for both climate change adaptation and mitigation, in addition to many areas of complementary research. The programme builds on research carried out previously internally, with other water companies and UKWIR.
105. Our AMP5 research and investigation programmes will support the need we highlighted in our SDS – to undertake strategic research in to the effects of climate change on our overall infrastructure. This will help inform our planning in future Price Reviews.
106. We have appointed leading university and consultancy research partners to support our climate change research activities. Cranfield University support us on adaptation research. In 2010, Cranfield University independently reviewed our strengths and weaknesses in relation to adaptation (Cranfield, 2010). This has helped develop our adaptation research programme.
107. We are also monitoring and involved in national adaptation research. In particular, we are supporting a number of UKWIR studies relating to climate change. For example, projects investigating the impacts of climate change on water and water treatment processes. We will closely monitor external research and other knowledge developments (such as Government policy and guidance) to incorporate this within our evolving research plans.
108. A similar exercise is being undertaken with carbon mitigation to ensure that we are able to deliver a holistic programme of investment in support of our SDS objective to mitigate our carbon footprint and adapt to climate change.

Asset flooding and climate change: Risk assessment scoping study

In May 2009 we began a research project with Imperial College to develop a risk assessment tool which will help us assess the risks of our assets to flooding. For each asset, the risk assessment methodology identifies:

- The probability of flooding, with and without climate change (based on EA data for 1 in 100 year return periods which include climate change)
- The vulnerability to flooding
- The consequence and impact of the flooding
- The interdependencies of other assets in the system.

6.6.2. *Modelling drainage areas*

109. In order to fully understand the impacts of climate change on our sewerage network we need to understand the networks performance. Drainage Area Plans (DAP) model a catchment's sewerage system and enable us to assess the performance of sewerage networks with respect to hydraulic, structural, operational and environmental criteria. This information can be used to:
 - Inform decisions about development control / planning (risk)
 - Develop intervention strategies
 - Assist in solution development
 - Provide data to external customers
 - Allow us to assess the impact of different climate change scenarios.
110. A Drainage Area Zone (DAZ) is a group of sewerage assets within a geographical boundary. We have 300 DAZs in our region. We are planning to develop and maintain a DAP for each of our regions DAZs over the next 25 years, in support of our SDS priority to stop our sewers flooding homes and businesses. In our current business plan we secured funding approval for the first phase of this long term objective – to develop 68 DAPs. The outputs will be used to support our future maintenance and enhancement proposals.
111. We will also be participating in three multi-agency studies. 31 of the 68 DAPs are specifically being modelled so that the outputs can contribute to these three studies which have been identified as areas of concern by local authorities and the EA. These areas are Hull, Leeds and Sheffield. The remaining 37 plans are for drainage area zones across the region and represent a cross section of urban and rural catchments.
112. These models will help improve our understanding of the impact of deterioration of our assets, the impacts of climate change and of supply and demand pressures. This will allow us to predict impacts on our network with more confidence in the future, thereby supporting our development of a quantitative climate change risk assessment.

- 113. Looking ahead, a major challenge is the predicted increase in extreme weather events, in the form of convective rainfall which can be very intense and localised. We are working with industry experts in WaPUG (CIWEMs urban drainage group) to develop rainfall data which can be reliably used in modelling. This will help us understand the impact of generalised rainfall on our networks and the environment. Our ability to predict this kind of precipitation will be investigated further.
- 114. We are also further enhancing our significant 'real time' monitoring capabilities which will increase the visibility of our asset performance. In combination with our improving use of radar rainfall predictions this will help us improve our response to extreme weather events in the future.

6.6.3. *Modelling sewer assets*

- 115. The most significant customer impact from the failure of the sewerage system is the flooding of their homes and businesses. It is likely that changing rainfall patterns will have a direct effect on the occurrence of blockages and resulting flooding. Such failures can be caused by both hydraulic capacity and structural and transient issues which lead to 'other causes' internal flooding. Hydraulic flooding is caused by a lack of capacity in the sewer system, the result of the network's inability to cope with the amount of flow entering the system.
- 116. We will use our predictive blockage models which are embedded within our Below Ground Asset Surveyor and Predictor (BGASP) system in order to monitor and understand this relationship. We plan to investigate and develop our systems to incorporate weather related parameters.
- 117. BGASP and other modelling software, such as overland flood routing, will enable us to better understand the risk of inundation of our assets and the potential impact of flooding on our customers. We are working with developers and our own contract partners to develop a range of Sustainable Urban Drainage solutions (SUDs) to both anticipated and current flooding problems.
- 118. We are also targeting capital expenditure to increase system capacity as well as managing changes in demand and new connections to our sewer network.
- 119. Our Flood Strategy Team liaise with other stakeholders to develop multi-agency understanding of current and future flooding risks, for example Local Authorities, the EA and Land Drainage bodies. A case example is provided below.

A partnership approach to surface water management

Following the unprecedented flooding of June 2007, we have been working in partnership with local authorities to develop a multi-agency approach to surface water management. The company now has strategic partnerships in place to address these issues with cities including Leeds, Bradford and Sheffield.

We have also developed an integrated strategic partnership with Hull City Council. The EA and the East Riding of Yorkshire Council are also important members of this group. Our sewerage and pumping facilities play a key role in the city's approach to surface water management. We have just completed a significant investment programme to enhance this network. To further enhance the partnership's understanding of the interdependencies between different networks and how these contribute to better flood risk management, we have also embarked on a major modelling exercise of the sewerage network.

We expect to bring forward investment plans, based on the multi-agency working we are undertaking in the region, as the part of the next Price Review process.

6.6.4. *Modelling the river environment*

120. Climate change is likely to impact on the flow and water quality of rivers. The water resource section above has described the work to understand climate change impacts on water resource yields and river flows to enable us to plan and invest to maintain customer levels of service. The impacts of climate change on water quality are also important, as it has the potential to drive changes in the standards that waste water treatment works are required to meet.
121. The water quality planning model, SIMCAT, is used to determine the regulatory discharge consent standards required from individual waste water treatment works to protect river water quality. We have worked in partnership with the EA to develop complete modelling coverage of the Yorkshire river network.
122. Functionally, SIMCAT mixes discharges and diffuse inputs with river waters and then routes flows in the river down through the catchment, applying water quality transformation processes en route. SIMCAT is able to predict flow and quality distributions at any selected point in the catchment and produce results as statistics for comparison with specific river quality standards. It can model a wide range of substances including nutrients and dangerous substances (metals, pesticides, etc) in addition to sanitary standards associated with discharge consents. It can be used to understand current river quality and predict the performance required to meet new or revised regulations.
123. We are planning to develop SIMCATs ability to assess climate change impacts on water quality. We are developing a first generation seasonal time series approach to water quality modelling to improve functionality for climate change parameters. We will be trialling this approach on the River Don in South Yorkshire. This work will enable us to model weather and climate impacts on water quality and determine the implications on discharge consent standards and the associated investment requirements, along with operational consequences.

6.7. *rtRIVERi – OUR VISION FOR INTEGRATED CATCHMENT MANAGEMENT*

124. It is our long term vision to integrate all our abstraction and discharge consents using a dynamic, optimally controlled system - we call this real time river integration or rtRIVERi. This will support us in our long term needs, including delivering increased water supply security, river quality and environmental improvements as well as significant reductions in our energy consumption and carbon footprint. This will support the resilience of our entire network.
125. Climate change coupled with population growth and new household formation will put water resources under increasing strain. In response, we recognise the need for a more integrated approach to water cycle management. One way in which we can contribute to a more integrated approach is by combining our water, sewerage and river network modelling strengths (outlined above) to enable one optimised approach.
126. In real terms, one aspect of this integrated response is the modernisation of abstraction licenses and discharge consents so that they are flexible enough to respond to real time environmental conditions. For example, in periods of high river flows there could be more abstraction and less stringent discharge consents, and vice versa in periods of low flows. With additional use of automation and remote operation, our water and waste water assets could respond to customer and environmental needs in real time, in the most optimal way across the region.
127. There are a wide range of potential benefits from our rtRIVERi approach. We list some of these below:

Environment

- Reduced carbon emissions
- Measurable aquatic environmental improvements
- Flexible approach supports climate change adaptation

Financial

- Reduced energy consumption and associated costs, including carbon

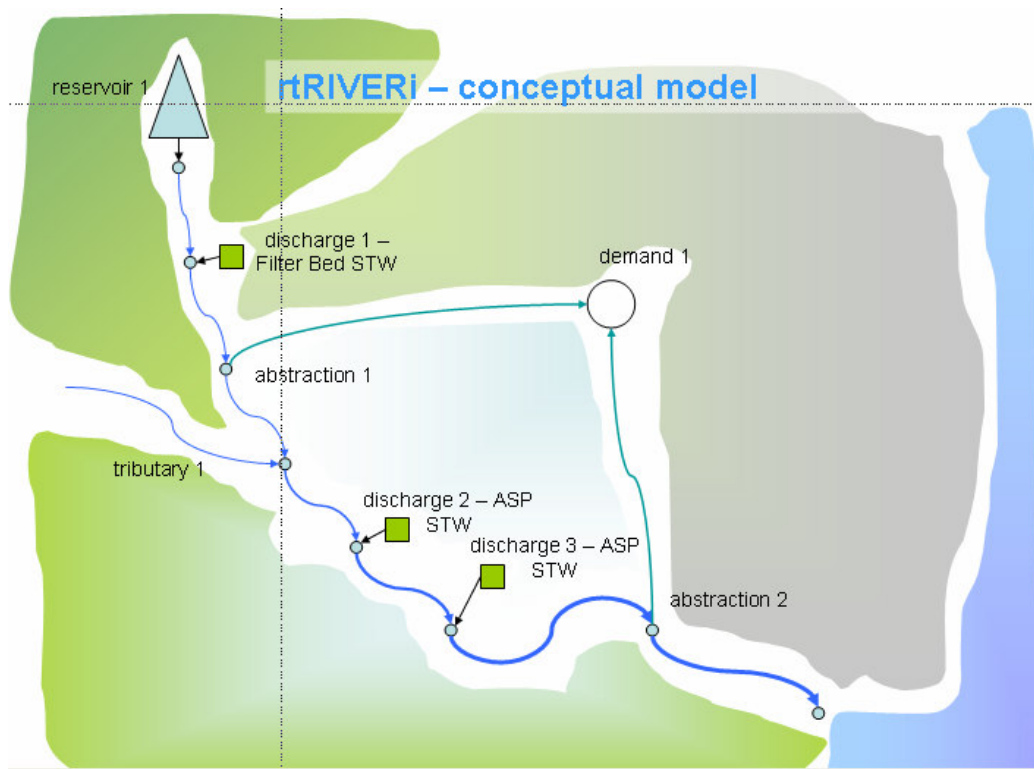
Stakeholder and customers

- Potential for reduced customer bills
- A more sustainable approach to water management
- Increased water supply security

Regulators

- Help to achieve regulatory visions of the future
- Help to achieve Water Framework Directive aquatic requirements
- Improvements for customers

Figure 8 – The rtRIVERi conceptual model



128. The benefits of rtRIVERi cannot be achieved by us alone. We are working in collaboration with a variety of stakeholders, including the EA, Defra and our Environmental Advisory Panel (EAP). This collaborative approach will not only help to build a sustainable future for our region, but help work towards regional economic recovery.

6.8. CONCLUSIONS

129. AMP5 investment will significantly develop our adaptive capacity, for example through our research, investigations and modelling.
130. As our technical knowledge develops over time and we continue to embed climate change risk management within our business, we will adapt using four key principles:
- to respond in a **sustainable** way, with economic, social and environmental considerations
 - to be **flexible** and responsive within a long term planning framework
 - to **balance** short and long term needs, without abortive investment or missed opportunities
 - to **collaborate** with others as we cannot adapt effectively alone.

CONCLUSIONS

131. We recognise climate change as a long term strategic risk. This report is a snap shot in time of our approach, current work and future plans to maintain levels of customer service in a changing climate. We have structured our report to comply with the legal direction statement and associated guidance received from the Secretary of State for Environment, Food and Rural Affairs.
132. The Executive Summary in Section 1 of this report provides an overview of how climate change adaptation is being embedded within our organisation. We recognise the need to adapt to climate change in order to maintain levels of service for our customers and the environment.
133. Many of the activities in our current asset management plan (for the period 2010 to 2015) support the need to build our adaptive capacity in order to prepare for future climate change. As our knowledge develops, we envisage that adaptation (and mitigation) will be significant in our future plans. We look forward to working collaboratively with our regulators to agree any necessary action, robustly justified through scientific and economic analysis.
134. Climate change knowledge and understanding will develop and evolve over time in light of research, policy, and ultimately with the weather we actually experience over the coming decades. Our plans must therefore be flexible, sustainable and integrated in to the regional and national adaptation measures and programmes.
135. The established and successful regulatory Price Review process provides the opportunity to comprehensively review planning needs every five years. We conclude that adaptation should be an integral part of the water industry's Price Review process and fully integrated into our operations, planning and investment. This would enable our adaptation plans to be scrutinised and supported by both our customers and our regulators.
136. There is a significant opportunity to review the current approach to water management in this country by considering all long term pressures on the whole water cycle. We will continue to raise our ideas and encourage debate with the Government, our regulators, customers and other stakeholders. It is a logical thing to do in light of climate change.

GLOSSARY

AMP	Asset Management Plan
AMP4	Asset Management Plan 5 (2005 to 2010)
AMP5	Asset Management Plan 5 (2010 to 2015)
AMP6	Asset Management Plan 6 (2015 to 2020)
BGASP	Below Group Asset Surveyor and Predictor
BRM	Business Risk Model
CCRA	Climate Change Risk Assessment
CCWater	The Consumer Council for Water
CRMT	Company Risk Management Team
CRSA	Control Risk Self Assessment
DAP	Drainage Area Plan
DAZ	Drainage Area Zone
Defra	The Government Department for Environment, Food and Rural Affairs
DWI	The Drinking Water Inspectorate
EA	The Environment Agency
EAP	Yorkshire Water's independent Environmental Advisory Panel
IMS	Integrated Management System
ISO	International Standards Office
LEADA	Leading Edge Asset Decisions Assessment
MI/d	Mega litres per day
NE	Natural England
Ofwat	The Office of Water Services
PR04	The 2004 Price Review
PR09	The 2009 Price Review
QRA	Quantitative Risk Assessment
rtRIVERi	Real Time River Integration: our integrated catchment management approach
rtWRAP	Real Time Water Resources Allocation Plan

SDS	Yorkshire Water's 25 year Strategic Direction Statement
SEMD	Security and Emergency Measures Direction
SIMCAT	A water quality planning model
SSSI	Sites of Special Scientific Interest
SUDs	Sustainable Urban Drainage solutions
UKCIP	The UK Climate Impacts Programme
UKCIP02	The UK Climate Impact Projections 2002 (fourth generation)
UKCP09	The UK Climate Projections 2009 (fifth generation)
UKWIR	UK Water Industry Research
WaPUG	CIWEMs Urban Drainage Group
WaterUK	The national water industry collaborative body
WRAP	Water Resources Allocation Plan
WRAPsim	Water Resources Allocation Plan simulation software
WRMP	Water Resource Management Plan

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APPENDIX 1: DEFRA EXECUTIVE SUMMARY TEMPLATE

1. Information on organisation	
Name of organisation	Yorkshire Water
<p><i>Organisation's functions, mission, aims, and objectives affected by the impacts of climate change</i></p> <p style="text-align: center;">Maintaining levels of service in a changing climate</p> <p>We are water company providing water and waste water services to the Yorkshire region.</p> <p>In 2007 we produced our Strategic Direction Statement (SDS) that set out our longer term objectives for the next 25 years. We identified five strategic objectives delivered by ten priorities. Adapting to climate change is one of the priorities.</p> <p>Our approach to climate change includes three main elements: Adaptation, Mitigation and Communication.</p> <p>See Section 2.3 for more details.</p> <p>There is potential for climate change to impact on all our core services.</p> <p>See Section 5 for more details.</p>	
2. Business preparedness before Direction to report was issued	
<p><i>Has your organisation previously assessed the risks from climate change?</i></p> <p>We undertook our first cross business climate change risk assessment in 2008 in order to consider adaptation investment needs in our business plan for the current five year period.</p> <p>See Section 5 for more details.</p>	
<p><i>If so, how were these risks and any mitigating action incorporated into the operation of your organisation?</i></p> <p>We found the 2008 assessment useful in helping to develop our understanding of our potential risks from climate change.</p> <p>See Section 5 for more details.</p> <p>We have incorporated a number of activities that will support future adaptation into our business plan for the current five year period.</p> <p>See Section 6 for more details.</p>	

3. Identifying risks due to the impacts of climate change

What evidence, methods, expertise and level of investment have been used when investigating the potential impacts of climate change?

The cross business climate change risk assessments in 2008 and our current programme of risk assessment have been based on UKCIP02 and UKCP09 scenarios for Yorkshire.

Our approach to date has been a facilitated, qualitative company expert panel approach. We have a significant adaptation research and investigation programme which involves collaboration with a number of partners and universities.

We aim to use our developing technical understanding of the impacts of climate change to our assets and services to develop quantitative climate change risk assessments.

See Sections 5 and 6 for more details.

4. Assessing risks

How does your organisation quantify the impact and likelihood of risks occurring?

We detail our asset and risk management approach in Section 5.

5. Uncertainties and assumptions

What uncertainties have been identified in evaluating the risks due to climate change?

What assumptions have been made?

Our current climate change risk assessments are qualitative, using expert opinion. We aim to develop quantitative climate change risk assessments as we continue to develop our understanding.

See Sections 5 for more details.

6. Addressing current and future risks due to climate change – summary (one line is required per risk)

Business function	Climate variable (e.g. increase in temperature)	Primary impact of climate variable (e.g. health)	Threshold(s) above which this will affect your organisation	Likelihood of threshold(s) being exceeded in the future and confidence in the assessment	Potential impacts on organisation and stakeholders	Proposed action to mitigate impact	Timescale over which risks are expected to materialise and action is planned
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Please see the findings of our latest qualitative climate change risk assessment in Section 5. This has been structured using the headings from this table.

7. Barriers to implementing adaptation programme

What are the main barriers to implementing adaptive action?

Has the process of doing this assessment helped you identify any barriers to adaptation that do not lie under your control?

The water industry regulatory framework supports climate change adaptation. We also believe there is a need for a more integrated, overarching approach to water cycle management in order to adapt effectively. We discuss this and other opportunities in Section 4.

8. Report and review

How will the outcome of the adaptation programme be monitored and evaluated and what is the timetable for this?

We describe our current activities which support climate change adaptation in Section 6.

The cyclical nature of our risk management framework is outlined in Section 5, this is integrated into our regulatory business planning and will inform our future proposals.

How do you propose to monitor the thresholds above which impacts will pose a threat to your organisation (including the likelihood of these thresholds being exceeded and the scale of the potential impact)?

We are using regulated customer service measures as indicators. These are monitored constantly and inform the detail of our business plans. We continue to develop our knowledge of the impacts of climate change on our assets and services.

See Sections 5 and 6 for more details.

How will the benefits of the programme be realised and how will this feed into the next risk assessment and options appraisal?

Our activities in support of climate change adaptation are integrated within our regulated business planning, described in Sections 4 and 6.

The cyclical nature of our risk management framework is outlined in Section 5, this is integrated into our regulatory business planning and will inform our future proposals.

How have you incorporated flexibility into your approach?

The cyclical nature of our risk management framework is outlined in Section 5, this is integrated into our regulatory business planning and will inform our future proposals.

We continue to develop our knowledge on the detailed impacts of climate change on our assets

and services. We seek continual improvement and innovation in all aspects of our organisation.

9. Recognising opportunities

What opportunities due to the effects of climate change and which the organisation can exploit have been identified?

We believe there is opportunity for a more integrated, overarching approach to water cycle management in order to adapt effectively. We discuss this and other opportunities in Section 4.

10. Further comments / information

Do you have any further information or comments which would inform Defra (e.g. feedback on the process, the statutory guidance, evidence availability, issues when implementing adaptation programmes, challenges, etc)?

The existing water industry regulatory framework would be strengthened by the incorporation of future requirements for adaptation reporting. This would add further drive to the industry's response to climate change.

We believe there is opportunity for a more integrated, overarching approach to water cycle management in order to adapt effectively. We discuss this and other opportunities in Section 4.

Our Chief Executive describes our position in his Foreword to this report.

APPENDIX 2: DEFRA DIRECTION STATEMENT

Direction

Climate Change Adaptation Report by Yorkshire Water Ltd Direction 2010

The Secretary of State has been conferred powers by section 62(1) of the Climate Change Act 2008 to direct certain persons or bodies known as "reporting authorities"¹ to give reports about adaptation to climate change.

He makes the following Direction to Yorkshire Water Ltd under the powers conferred by that section:

Citation and Commencement

1. This Direction may be cited as the Climate Change Adaptation Report by Yorkshire Water Ltd Direction 2010. It has immediate effect.

Interpretation

2. -In this Direction-
"the reporting authority" means Yorkshire Water Ltd.

Direction

3. The reporting authority must prepare and send to the Secretary of State a report containing:
 - (a) an assessment of the current and predicted impact of climate change in relation to the reporting authority's functions;
 - (b) a statement of the reporting authority's proposals and policies for adapting to climate change in the exercise of its functions and the time-scales for introducing those proposals and policies.
4. The assessment of impact referred to in paragraph 3(a) must include:
 - (a) a summary of the statutory and other functions of the reporting authority;
 - (b) the methodology used to assess the current and predicted impacts of climate change in relation to those functions; and
 - (c) the findings of the assessment of the current and predicted impact of climate change in relation to those functions.
5. This report must be prepared by **31 January 2011**.

APPENDIX 3: BARRIERS TO ADAPTATION IN THE WATER INDUSTRY

Below, we provide further detail on barriers to effective climate change adaptation. Details are summarised in Table 1 (Section 4) of the main report.

A national vision and framework for adaptation

We recognise the substantial efforts being taken to prepare for climate change in the water sector, with visible action from the water and waste water companies, regulators, stakeholders and the Government. Currently, because everyone's understanding of climate change continues to develop to maturity, there are differing views on how to assess climate risks, and when and how it is appropriate to respond. In order to allow the water industry and its regulators to act with confidence in their preparations for climate change, we ask the Government to provide direction on the relative priority of climate change adaptation and their expectations of the relevant organisations involved. We offer our support to the Government and our regulators in helping them define an effective climate change adaptation vision and framework for the industry.

Interdependencies – integrated water management planning

We welcome moves towards integrated regulation and planning of the water cycle. Effective adaptation in the UK will require a more joined-up approach to all aspects of our country's water management activities. The nature of our business and the location of many of our assets mean that we are intrinsically linked to the water environment and are therefore well placed to have a strong role in this debate. For example, climate change adaptation of our sewer network needs to be considered alongside surface water management and sustainable urban drainage. We will continue to work collaboratively with the Government and our regulators to consider the future of water management in our country and help ensure an effective approach.

Water industry regulation – the Price Review cycle

The five year business planning cycle supports adaptation by ensuring a fresh look every five years and allowing investment based only on the latest and best information. This has been an effective approach to date. However, we note findings in the recent report for Defra 'Adapting to climate change in the infrastructure sectors':

"the strong emphasis on short term value for money...mean that adaptation requirements are not yet being addressed on a systematic basis. Whilst in principle the regulatory framework is broadly fit for purpose in the context of climate resilience, there is a need to strengthen the focus on long term resilience"

PricewaterhouseCoopers LLP, 2010

The 25 year view of the SDS has helped to set the longer term context for shorter term investment periods. The water industry needs to work with its regulators to continue to develop this approach in order to effectively consider long term plans and strategies, including those required to respond effectively to climate change. The Government can support long term planning and strategic considerations within the water industry by clarifying expectations of regulators and water companies with this regard.

Water industry regulation – customer willingness and ability to pay

In the current water industry regulatory framework, investment to maintain levels of service is funded through customer bills, and needs clear customer support. In responding to future climate change this approach highlights two sets of challenging questions:

- Who should pay and when? Will current customers be willing to pay for future potential impacts of climate change? Is it right that current customers should pay? Levels of customer support for early action for climate change are currently unclear.
- If customers are to fund any necessary action, how does the industry maintain affordable customer bills if significant investment is required?

We feel these questions require open debate, and we therefore ask the Government to include these questions within their current review of the water industry. We are happy to support the Government and our regulators in considering these questions with the industry, its customers and stakeholders.

Water industry regulation - quality compliance

It is widely accepted that flexibility is important to be able to respond to the uncertainties around future climate change. New regulatory requirements for environmental water quality standards can result in a restricted ability for water companies to act flexibly. This is because robust assets (often fixed, substantial structures) with long asset lives and energy intensive processes are often required in order to guarantee effective compliance with strict standards. As a result these assets can be inflexible to future modification for climate change. In addition, these assets often have substantial embedded and operational carbon footprints, which set our emissions forecasts to increase rather than decrease.

At Yorkshire Water, we have responded with a twin track approach of compliance and innovation. Whilst our priority is always to comply with any legal duties placed on us, we also recognise that the resulting asset base may not support climate change adaptation or mitigation. Therefore, we are also investing significantly in our research and innovation programmes to find more effective and efficient ways of delivering the required compliance. We ask the Government to ensure that the requirements of any new environmental legislation are sustainable, both economically (affordable, with clear cost benefit), socially (supports flexibility for adaptation) and environmentally (protecting the holistic environment, not just the water environment).

Maintaining levels of service may become increasingly difficult due to future climate change. It is widely accepted that the frameworks behind some water and environmental quality standards were designed many years ago and are often highly conservative to ensure the highest levels of protection for human health and the environment. Whilst there is no question for anything but the highest levels of human health and environmental protection, it may be possible to maintain 'real' protection standards whilst reviewing 'legal' standards. Science and modelling capabilities have progressed a great deal in recent years to allow more accurate assessments. It may therefore be valuable to review water quality assessment frameworks to reduce the burden without reducing levels of health or environmental protection, simply by reducing the inherent conservatism in the calculation for a quality parameter. We ask the Government and its regulators to investigate the potential for savings in this area, which would support both adaptation and mitigation.

Water industry regulation – resilience through renewable energy self-generation

Water companies are increasingly focused on self-generation of renewable energy. This focus is for many reasons, including lower operating costs for customers and lower greenhouse gas emissions. Renewable self-generation also helps adaptation by increasing resilience of key assets, which will be better able to continue operating despite external factors such as national grid interruptions. In an emergency, this means that those assets would put less pressure on the national grid. With the right investment the self-generation assets may even be able to operate to support the grid in such times.

Current Ofwat policy restricts the ability of water companies to pursue renewable technologies which are not intrinsically linked with the asset base, even where cost effective and delivering a wealth of benefits. We were pleased to see the recent consultation encouraging Scottish Water to take a central role in providing green energy for Scotland through a concerted approach to realise the capabilities of their asset base (<http://www.scotland.gov.uk/Publications/2010/12/14111932/0>). In the short term, we ask the Government and Ofwat to review the renewable self-generation policy position in England and Wales to allow a more flexible approach. In the longer term we ask the Government to consider a similar strategy for England and Wales to enable water companies to fully pursue the climate change and other benefits.

Effective use of climate change projections

The introduction of UKCP09 provided significant improvement in the data and tools available to support evaluation of adaptation risks and response options. We have started to embed the systematic use of UKCP09 within our business as part of our SDS strategy to develop asset specific knowledge which is required to enable us to make effective decisions.

The probabilistic approach introduced in UKCP09 will help the industry make more informed decisions about potential climate change adaptation activities. However, it also raises a challenge for users to effectively incorporate the uncertainty. Currently, the industry has not agreed a common approach to the use of the probabilistic functions of UKCP09 and it is unclear what approach regulators will accept as robust justification for investment approval. In order to ensure a satisfactorily robust approach whilst minimising the potential for abortive analysis, we will seek to work collaboratively with the industry to develop a consistent methodology for the use of UKCP09.

It would also be beneficial for the Government to provide a national approach so that the water industry can ensure it is working in alignment with other sectors.

Enhancing future climate change projections

It was unfortunate that UKCP09 was published too late for significant inclusion in the water industry's 2009 Price Review. We would encourage any future releases of significant modelling developments to consider the water industry Price Review timescales in order to allow timely incorporation into our regulated investment activities. We would also welcome clarity on future timescales of the development and enhancement of climate change modelling by UKCIP (and/or other organisations).

For the water industry, extreme weather events are highly important to our adaptation preparations. It is the extremes that are often the key in determining the right operational activities and investment decisions. UKCP09 is most confident at the average forecasts, but less confident at the extremes. Therefore, we would welcome further research and focus on the extremes of climate change from UKCIP (and/or other organisations).

Interdependencies – supply chain

We have a vast supply chain on which it depends for critical resources, such as chemicals, energy, fuels and IT networks. The recent harsh winters in early and late 2010 act to highlight some of the significant potential impacts of climatic extremes on our operations. We recognise that we need to consider the supply chain implications further to ensure sufficiently effective resilience to future climate change. We will be looking to work collaboratively with our supply chain to consider these interdependencies and how best to manage them. At a national level, there may be difficulties in clarifying roles and responsibilities and we therefore ask for government mechanisms that support considerations and preparations in this area.

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